THE FOUNDRY

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The Old Boyden Foundry Passes Into History

This shop, however, is succeeded by the magnificent new plant of the Barlow Foundry Co., which embodies novel features of design

By E C Kreutzberg

THE completion of the new plant of the Barlow Foundry Co., Newark, N. J., is an event of more than passing interest to the foundry industry of the country, since it marks the first step into oblivion of the company's famous old casting shop at 26 Orange street, that city. Here Seth Boyden, after conducting experiments for six years, discovered malleable iron, an achievement which the citizens of Newark commemorated by erecting a statute of him in one of their public parks. Boyden founded the business in 1826, and until a few weeks ago iron had been cast continuously in the old building. Its long period of usefulness as a foundry now is at an end. All the equipment has been removd to the new location, and the old structure is to be razed in the near future. The new plant, which is located in the Waverly section of Newark, formally was opened on May 2, when it was inspected by several hundred of the Barlow company's friends in the trade, who were unanimous in declaring it one of the most modern and best constructed establishments of its type in the vicinity of Newark. On May 12 the first heat was run off, and since that time the record of operations has justified the care and forethough bestowed upon the construction and equipment of the plant. The plant consists of a foundry, 60x180 feet, and a miscellaneous building, 200 feet long and 110 feet wide at one end and 70 feet at the other. A malleable foundry, 70x350 feet, is to be erected next spring, while work is to be commenced immediately upon the erection of an 120-foot extension to the new gray iron foundry foundry, which will give that building a total length of 360 feet.

A feature of the foundry proper is the unusually small amount of floor space devoted to purposes other than molding. The cupola is located outside of the buildings and the only space not utilized for molding is a portion of one of the side bays, 24x60 feet, in which the core-making department is located. The foundry forms one wing of a U-shaped group, of which the miscellaneous building is the base, and the proposed malleable foundry will form the other wing. The foundry is separated from the miscellaneous building by a fire wall, containing three entrances, closed by fire doors. The other end is shut off by a curtain wall, which will be removed when the extension is completed. The building is of brick and steel construction, with a central monitor. The sides of the monitor and the building are provided with steel sash. The large window area insures an abundance of light, and to supplement the ventilating function of the windows, the roof of the monitor is equipped with Larson revolving head suction ventilators, spaced at intervals of 30 feet the entire length of the building. Artificial illumination is provided by two rows of 250-watt tungsten lamps, spaced 20 feet, the full length of the building, and two rows of 100-watt lamps, spaced 10 feet. The latter are located directly over the molding benches. The roof of the foundry is of unit cement slab and tile construction,

FIG. 1—POURING BAY, SHOWING OVERHEAD TROLLEY FOR TRANSFERRING LADLES TO MAIN BAY

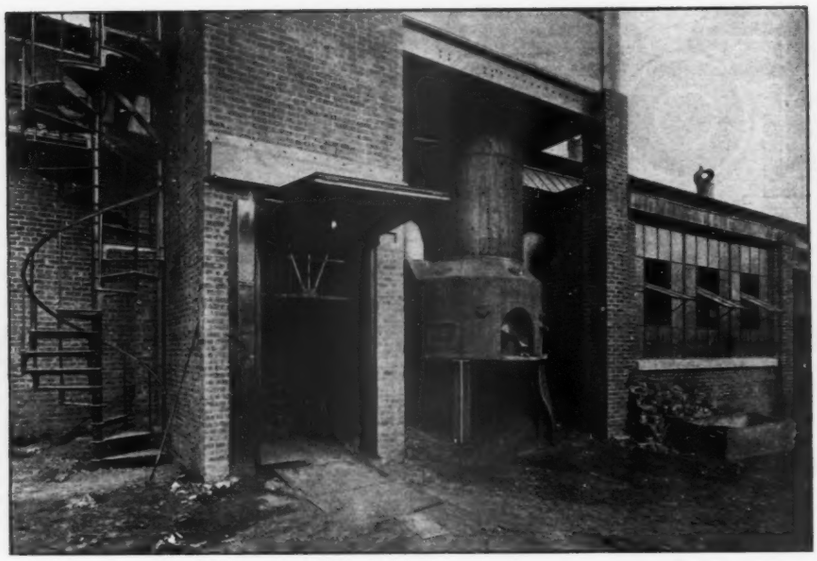


FIG 2.—CUPOLA LOCATED OUTSIDE THE FOUNDRY. THIS ILLUSTRATION ALSO SHOWS THE BLOWER HOUSE, ELEVATOR AND SPIRAL STAIRWAY TO THE CHARGING PLATFORM

while the foundry floor consists of building sand, covered to a depth of 6 inches by rolled clay. The building is divided into a center bay, 24 feet wide, and two side bays, each 18 feet wide. The center bay is commanded by a 5-ton, three-motor traveling crane, which is mounted on an overhead runway running the full length of the shop. This crane may be operated either from a cab or from the floor. The steel columns which support the crane runway and the roof, are protected at their bases, to a height of 5 feet, by cylindrical steel shells filled with concrete. The water supply system consists of a 2-inch underground main, from which 1-inch connections are taken off at various points. These are provided with large cocks which drip into hogsheads set half into the floor.

The pouring spout of the cupola enters the foundry through an arched opening in the brick wall, as shown in Fig. 1. This portion of the bay is served by an overhead trolley for carrying ladles. The trolley is mounted on rails made of steel angles and channels riveted together, and is essentially an ordinary traveling crane trolley without the bridge. The trolley is provided with two motors, one for effecting the movement along the rails and the other for lifting and carrying the ladles of iron. These motors are operated by controllers on the floor level. The trolley commands the pouring spout of the cupola as well as a portion of the main bay, thus permitting ladles to be transferred to the main bay traveling crane.

FIG. 3—A BENCH MOLDER'S FLOOR, SHOWING CAST IRON BENCH AND CONCRETE SHELF

The foundry is equipped with a number of pneumatic molding machines of the Mumford and International types. Each of the 32 bench molders' floors is equipped with a cast iron molding bench and a shelf. The former is secured to the wall by two bolts. The latter is of a type which is original with the Barlow company. These shelves are of unit concrete slab construction, including one vertical slab, 6 feet long and 3 feet high, and one horizontal slab, 6 feet long and 1 foot wide. These two sections are held by a steel angle frame securely bolted to the wall. The sections were made separately and were assembled on the foundry floor. The shelves, by reason of their strength and durability, are superior to the wooden shelves which customarily are used for this purpose.

Core Department

The core department comprises several coremakers' benches and two core ovens. One of the ovens is 12 feet long, 8 feet wide and 6 feet high. It is provided with wide gage track and a rack car. The second oven was designed especially for the Barlow company, and is an unusually efficient installation. It is 20 feet long, 4 feet deep and 7½ feet high, being constructed of brick and steel. The oven, by means of vertical partitions, is divided into three compartments, one 2½ feet wide, one 6 feet wide and the third 3 feet wide. Each compartment, by means of horizontal partitions, is divided into two sections. The upright steel members are punched vertically at intervals of 2 inches. In these openings are inserted rods which form the racks on which the core trays are placed. For the narrow compartments, round rods are used, while in the wide compartments the rack is formed of small T-rails. Each compartment is provided with a steel plate door, with a ½-inch lining of asbestos. The oven is coke fired, the grate being located at one end and the flue at the other. Both are at the floor level.

The cupola, which was located outside of the building to conserve space inside of the foundry, is of the Colliau type, furnished by the J. W. Paxson Co., Philadelphia. It has a diameter of 72 inches and a capacity for melting 8 tons per hour. The cupola is located on the side of the foundry nearest the railroad switch, thus placing it within easy access of the raw materials stored in the yard. On both sides of the cupola, at right angles to the foundry wall, are brick walls supporting the charging platform, which is at a height of 16½ feet above the ground level. The charging platform is 20 x 28 feet, and is constructed of 7/16-inch smooth steel plates, supported by a heavy steel framing. The platform has a live load carrying capacity of 450 pounds per square foot, with a safety factor of four. The platform is served by an elevator having capacity of 3,000 pounds. The elevator is of the hydraulic type, but operates on oil instead of water in order to prevent trouble due to freezing in extreme cold weather. The walls of the charging platform are of reinforced concrete, thus making it possible to pile the raw materials, without damaging the walls. The wall on the foundry side of the charging platform is left low enough to enable the operator who conducts the charging to communicate at all times with the cupola tender below. The walls are provided with steel sash, while the roof is fitted with a suction ventilator.

FIG. 4—CORE OVEN, ESPECIALLY CONSTRUCTED FOR BARLOW FOUNDRY CO.

Specially Arranged Bins

The blower house, 10 x 20 feet, adjoins the cupola. The building is one story high and of brick construction. The blower is of the Wilbraham-Green type, chain-driven by a 25-horsepower motor. Air for the blower enters the building through a louvre over the entrance.

The railroad siding which enters the yard on a 10-foot trestle, is in the center of the space between the gray iron and the proposed malleable foundry. The trestle bents are of timber, with steel I-beam stringers. A portion of the space below the trestle is set aside for the storage of pig iron which is dumped from the incoming cars. The remainder of the space is occupied by storage bins. These are located between the trestle bents which are planked in order to form the vertical partitions. The bins are 12 x 25 feet each and 10 feet high. They are covered by corrugated iron roofing and are boarded at the front by removable planks. The contents of hopper cars are dumped into the bins through sliding hatches, located between the tracks, as shown in Fig. 5. The contents of box cars and gondolas are shoveled into the bins through removable panels in the roof. Four of the bins are devoted to the storage of coke, three for molding sand, one for core sand and one for clay.

The miscellaneous building is one-story, of brick and steel construction, with saw-tooth roof, and is provided with steel sash. The lower portion of the sash in the saw-teeth is fixed, but the top sash may be opened by means of a Drouve opening device controlled from the floor. The level portion of the roof is constructed of flat concrete slabs, 2 x 5 feet each, and 1½ inches thick, supported by steel purlins; these, in turn, are supported by light steel trusses. The concrete slabs afford ample insulation against the heat in summer and the cold in winter and afford an economical type of construction. The slab roof is finished with a coat of tar and gravel. The pitched roofs are constructed in a similar manner, consisting of cement tile units which overlap each other. The joints are cemented together and the tar and gravel coat is eliminated. The floor of the building is con-

FIG. 5—RAILROAD SIDING, SHOWING SLIDING HATCHES LEADING INTO RAW MATERIAL BINS

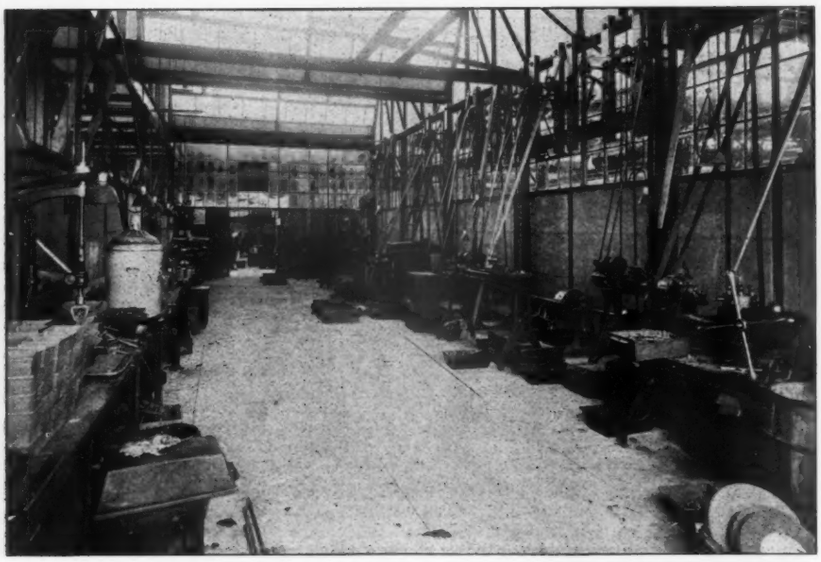


FIG. 6—VIEW OF MACHINE AND PATTERN FILING SHOP, SHOWING METHOD OF PARTITIONING OFF FLOOR SPACE IN MISCELLANEOUS BUILDING

crete, while the partitions are constructed of the same material as the roof. They are of the unit concrete slab construction, 2 x 5 feet and 1½ inches thick, being supported by a T and angle frame, resting on a concrete base. These partitions, while having all the advantages, and giving the appearance of permanent construction, may be dismantled and again set up in a new location. In this way, the floor space in any of the departments in the miscellaneous building may be adjusted readily to its requirements. The top portions of the partitions are of steel sash, affording ample ventilation and natural light. For artificial illumination, the building is provided throughout with tungsten lamps, which range from 40 to 100 watts. The roof is drained by leaders, which pass down through the interior of the building.

The cleaning department, which occupies a space 20 x 60 feet, in the miscellaneous building, contains four exhaust tumbling barrels, three 2 x 3 feet, and one 3 x 6 feet; three emery wheel stands and one sand blast tumbling barrel, 3 x 4 feet. The tumbling barrels and sand blast tumbler exhaust into a dust collector of the W. W. Sly type, which is provided with vibrator shaft for rapping the screens every six hours in order to prevent dust from clogging them. The exhaust from the emery wheels is conveyed by means of an exhaust fan into a separator of the cyclone type. The air for the sand blast tumbling barrel is furnished by a 10 x 16-inch compressor, which is chain-driven by a 35-horsepower motor.

The carpenter shop occupies a space 60 feet long, 20 feet wide at one end, and 10 feet wide at the other, in the miscellaneous building. It is equipped with a circular saw, band saw, jointer and other machinery. The machine shop occupies a space 20 x 60 feet, power-driven tools being arranged along one side. The other side is occupied by a bench for filing and fitting metal patterns, which are used almost entirely to the exclusion of wood patterns.

The pattern storage racks, which occupy a space 40 x 60 feet, are of exceedingly durable construction. They are spaced three to a bay, each rack being 12 feet high, 30 inches wide and 15 feet long. The frames are of steel angles, the upright members being punched for inserting rods which support the sheet steel shelves on which the patterns are stored. Although the shelves, as a rule, are 9 inches apart vertically, this distance can be varied to suit the requirements of the patterns, and to this end the holes in the vertical members are punched 3 inches apart.

The remainder of the space in the miscellaneous building is devoted largely to the sorting and shipping of castings. For making shipments by wagon and truck, the building is provided with a loading platform, while for rail shipments, the castings are elevated to a platform, which extends at the side of the railroad trestle at the height of box car doors. The elevator for handling castings has capacity of 3,000 pounds. At the side of the elevator shaft a 10 x 30-foot space is partitioned off for the wash room. Above this, on the roof, is a 20 x 40-

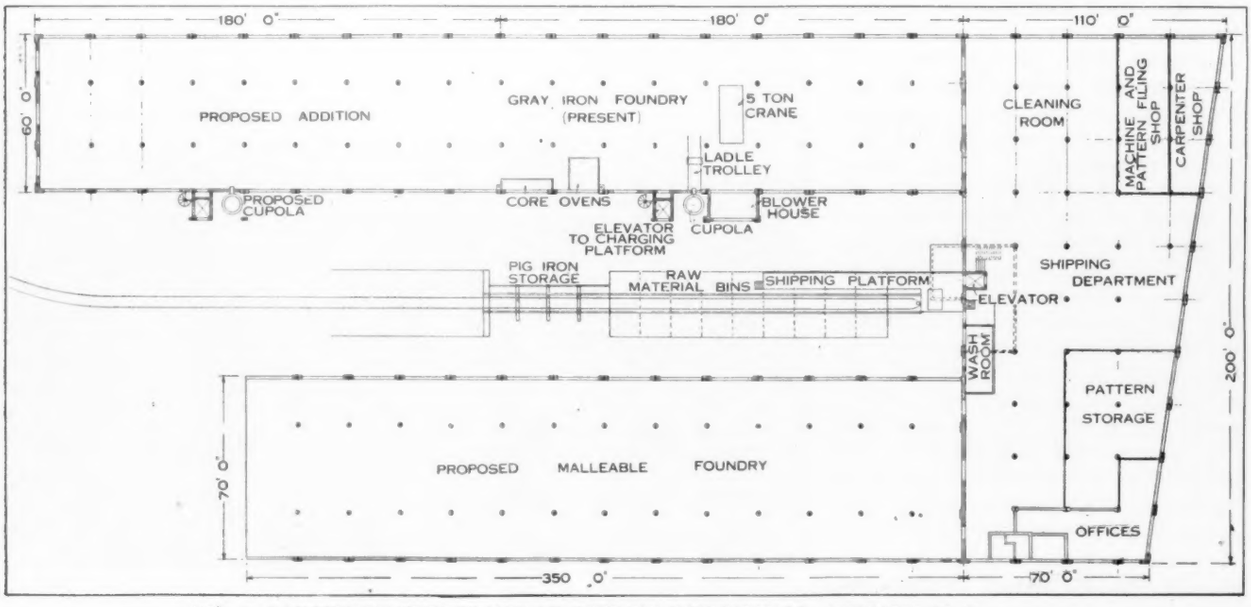


FIG. 7—LAYOUT OF NEW PLANT OF BARLOW FOUNDRY CO., NEWARK, N. J.

foot enclosure, which is used as a rest room for the workmen. At the side of the miscellaneous building is a small brick structure, in which is housed the pickeling department. The miscellaneous building is provided with a steam-heating system, which also provides hot water for the wash room and pickeling department.

The Barlow Foundry Co., instead of maintaining a power plant, finds it more economical to buy its current under contract with the local public service corporation. The current is delivered to the plant at 2,200 volts, two-phase. By means of transformers in the building, the current is reduced to 440 volts, three-phase. For use in the electric lighting system, the voltage is still further stepped-down. To economize floor space, the motors throughout the plant are suspended from the ceilings, wherever possible.

FIG. 8—CORNER OF PATTERN STORAGE, SHOWING DURABLE CONSTRUCTION OF RACKS

History of the Company

The history of the Barlow Foundry Co. may be summarized best by the following list of firm names under which it has been operated since its formation: Seth Boyden, 1826-1835; Boston Malleable Cast Iron & Steel Co., 1835-1837; Condit & Bolles, 1837-1843; Daniel Condit, 1843-1858; Condit & Barlow, 1858-1862; Condit, Barlow & Shove, 1862-1866; Barlow & Shove, 1866-1870; J. H. Barlow, 1870-1879; J. H. Barlow & Condit, 1879-1882; Barlow, Condit & Morris, 1882-1895; Morris & Barlow, 1895-1899, and Arthur E. Barlow, 1899-1907. In 1907, the business was incorporated as the Barlow Foundry Co., with Arthur E. Barlow, president. Mr. Barlow is the successor to two generations of the Barlow family in the business.

The other officers follow: Vice president, Wm. H. Nichols; secretary and general manager, Jos. McCartney, and treasurer, Richard H. Gatling. Mr. Gatling is a son of Dr. Gatling, the inventor of the "Gatling" gun. The directors comprise the officers and A. Parker Nevin, counsel to the National Association of Manufacturers; R. L. Riker, Newark, and Jos. M. Perrine, Jamesburg, N. J.

An Unusual Sign

The new plant is located on the main line of the Pennsylvania railroad between New York and Philadelphia, and to attract the attention of the thousands of passengers who ride by daily, the company has erected an unusual sign. The top row of letters is 20 inches high and the bottom row, 18 inches. The letters are of gray iron cast by the company and were enameled white by the J. L. Mott Iron Works, Trenton, N. J. At one side of the sign is a figure carved from wood, portraying a molder pouring a ladle of iron. This is painted to show the color effects of the molten iron. In this figure is immortalized Justus Helmbricht, foreman of the Barlow foundry for 35 years.

The new plant of the Barlow Foundry Co. was designed and built by the engineering organization of Walter Kidde, 140 Cedar street, New York.

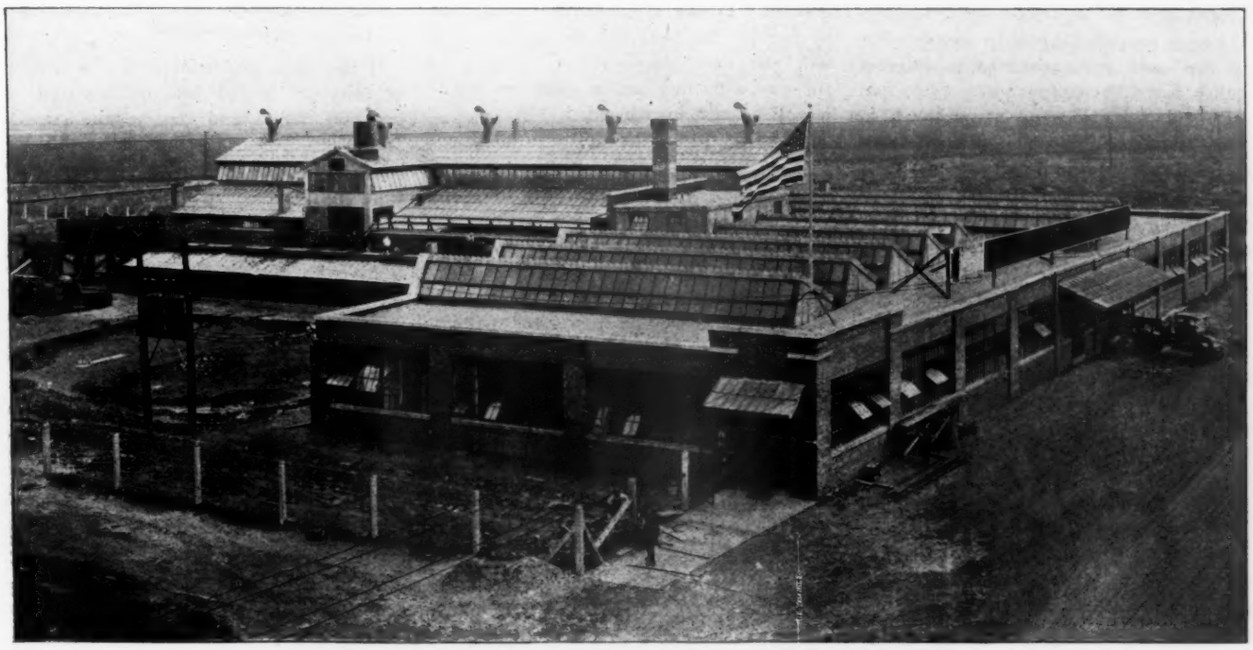


FIG. 9—EXTERIOR VIEW OF THE BARLOW FOUNDRY CO.'S PLANT

The Design and the Operation of the Cupola*

How the Gray Iron Foundry Furnace Should be Built and Worked to Obtain the Best Possible Results

By E L Rhead

IN THE design of a piece of apparatus for any given purpose, it is first necessary to study the conditions under which it will be used and the variations in condition possible as the result of accidental and functional changes, and also its connection with and dependence on other appliances with which it will have to act in conjunction, and by which its efficiency will be largely affected.

In melting iron for the foundry, the cupola holds the position of the first importance, and its behavior will determine to a large extent the success attained not only in this particular department of foundry work, but also in the general success.

The object aimed at in the successful operation of a cupola is to provide a supply of molten iron sufficiently hot for the purpose in hand as rapidly or as regularly as possible, as the case may be, with the minimum of cost both in labor and fuel and attention. It is a reliable appliance whose working can be reduced almost to a standard, and the results relied on with certainty, so long as working conditions do not depart from the normal to a greater extent than is likely to occur from the usual minor accidental circumstance of daily work.

It may be called upon to supply, during the same run, metal of a different quality for different purposes, or it may run for long periods on material of the same character. Special features may be necessary in the latter case, but in all circumstances the primary object is to secure rapid, hot and economical melting.

Condition for Hot and Economical Melting

In order to do this it will be necessary first to attain a temperature high enough to melt and superheat the metal sufficiently to enable the mold to be filled, while the metal retains all its constituents in perfect solution, so that cooling and solidification can proceed regularly. It should also generate sufficient heat to melt the metal and raise its temperature to the desired limit with as little fuel as possible. The amount of heat required for these purposes is a perfectly definite amount, depending only on the melting point, and the specific and latent heats of the metal. In this connection it must be borne in mind that the burning of a given fuel can only generate a certain quantity of heat per unit weight consumed under the best possible conditions. This depends on its composition only. Whether this amount is generated depends on how completely the fuel is burnt. Carbon, it will be remembered burns in two stages, to the monixide CO, and the dioxide CO_2. The maximum amount of heat is produced by the latter change, but instead of the former change producing a half of the amount, it only produces something less than one-third of the total. It is therefore obvious that the combustion should be made as complete as possible. Complete combustion can only be attained when there is a sufficient excess of air to furnish oxygen. If in the burning of coke or other carbonaceous fuels, there is a *local* excess of oxygen, carbon dioxide may be formed, but if that gas comes into contact with carbon at a sufficiently high temperature —say, above redness—the carbon deprives it of half its oxygen and reduces it to carbon monoxide. Both factors must be reckoned with, namely, temperature and contact. If the temperature is too low to furnish the heat for the reduction, it will not take place, and if contact of the gas with the carbon does not occur it will remain unreduced.

These considerations are of the greatest importance in dealing with the blast, its quantity, distribution and pressure, and also with the rapidity of the gas current passing through the cupola, the size of coke and its quality. Any condition making an increase in the amount of carbon dioxide in the gases passing from the furnace must result from an increased development of heat in the cupola from the coke burnt. It must not be overlooked that the carbon monoxide will, *if still hot enough* to ignite, burn in an excess of air and produce carbon dioxide with the generation of much heat.

Of equal importance is the economical application of the heat generated. In ordinary cases, heat is only communicated to one body by another by contact or by radiation. In the case of gases only by actual contact, as gases possess little radiating power, so that in a cupola heating of the metal and other materials must result from (*a*) actual contact with incandescent coke, (*b*) heat radiated from the surrounding coke—but only by the surface coke— if two pieces of glowing coke are one behind the other, radiant heat only reaches the metal from the surface immediately facing it; (*c*) by heat abstracted from hot gases impinging on the surface of the metal. Since the final product of the burning is gaseous, the part played by the gases is of primary importance. By far the greater part of the heat generated in the furnace is first taken up by the gases and by them distributed in the furnace. Consequently any consideration that influences the manner of distribution or the completeness of the contact of the gases with the solid materials in the furnace will produce its due effect on the working of the cupola, irregular distribution leading to imperfect contact and irregular heating with incomplete cooling of the gases and loss of heat. Incidentally, the region of high temperature extends higher in the furnace, either generally or locally, and in some cases the lining of the furnace will suffer.

Means Necessary to Secure the Con-Conditions

It has been pointed out that a certain quantity of useful heat is required to melt the metal and slag in the cupola, and that a certain quantity will be wasted or lost in various ways. That heat may be considered lost which is not transferred to the metal and slag. These losses comprise (*a*) loss by radiation from the casing of the furnace; (*b*) sensible heat carried away by the hot gases from the throat; (*c*) undeveloped heat represented by the carbon monoxide in the gases.

To a greater or less extent these are unavoidable, and the cupola will be most efficient in which these losses are reduced to a minimum. In ordinary circumstances the whole of the heat is derived from active combustion, more being carried in mechanically by using a hot blast as in iron smelting blast furnaces. A brief glance at these losses will point out some useful conclusions.

Loss by radiation will depend on the

*Presented at the annual meeting of the British Foundrymen's Association, held at Leicester, Eng.

temperature of the casing and will depend on the rate at which heat is conducted to it from the hot interior by the lining. The thickness of the lining and its conductivity will thus enter into the consideration. The latter varies comparatively little for firebrick, but its thickness will, of course, have an effect.

The extent of the surface of the casing, compared with the sectional area of the furnace, has a large influence. As the area increases with the *square* of the diameter and the circumference with the diameter the proportion of surface to capacity rapidly diminishes, as shown by the following:

Diameter of cupola.	Sectional area.	Circumference.	Surface. Cubic capacity.	Cu. capacity feet. Area of surface.
1	0.7854	3.1416	4	0.25
2	3.1416	6.2832	2	0.5
3	7.0686	9.4242	1.3	0.75

Obviously, the loss of heat from this cause must be less in the case of wider cupolas than in narrow ones, and greater economy must result. The only practicable means of preventing this loss is by circulating the air blast round the cupola and carrying the heat thus taken up back into the cupola, so that so far as the portion of the cupola treated is concerned the loss of heat is avoided. Obviously, any cooling of the metal reservoir is out of the question, as the circulation of air round it would remove heat more rapidly than it would be dissipated by ordinary radiation. Clearly, also, the largest loss will occur in the hottest part of the furnace—the melting zone and immediately below it.

Air Belt

Any cooling that may be effected will tend to protect the lining of this most important part of the furnace and maintain the lines of the furnace interior.

In some cupolas the air belt is constructed inside the casing, thus reducing the thickness of the lining and increasing the heating effect. Reference may also be made to casings placed in the upper part of the furnace, avowedly for the purpose of heating the air blast. To avoid undue importance being attached to this point, the value of the saving effected will be stated.

A hundredweight of coke containing 90 per cent carbon requires approximately 15,000 cubic feet of air at the ordinary pressure for its complete combustion, allowing for no excess, equal to 12 times its own weight. This is assuming its conversion to CO_2 and would produce the same volume of gas with a weight equal to 13 times that of the carbon burnt. This, if heated 1 degree Fahr. would contain 328 B. T. U., or if heated 100 degrees Fahr. 32,800 B. T. U., less heat than would be generated by the complete combustion of 2.5 pounds of the coke. Its effect on the working of the cupola, however, is greater than the smallness of the amount would imply. The chilling effect of the air as it enters the cupola is reduced and there is less tendency to form obstructions. A better distribution is consequently assured.

Heat in Gases Leaving Furnace

There is little probability of the gases emerging from an ordinary cupola being cooled below 500 degrees Fahr. and they usually reach 650-700 degrees or even higher. It follows that at the former figure the loss from this cause would be equal to a little less than 13.5 pounds of coke or 12 per cent of the weight of coke burnt, calculated on the burning of the carbon to carbon dioxide. If calculated on carbon monoxide the percentage is nearly 18, owing to the smaller amount of heat generated, although the weight of gases is only a little more than half, 7/13, for the same weight of fuel burnt.

If two-thirds of the carbon burns to CO_2 and one-third to CO, the loss is approximately 14 per cent. The actual loss in many cases is more than double this amount as the temperature of the escaping gases is often 1,000 degrees Fahr., or even higher, and the proportion of CO greater. Further, the quantity of air supplied is in excess. The present figures are based on the minimum quantity. Any modification that will cause a reduction in the temperature of the escaping gases and in their amount will tend to economical working.

Since the initial temperature of the gases is fixed by the temperature of melting required for teeming purposes, it follows that this will depend on the extent of the subsequent cooling. In this connection the amount of the gases as well as the temperature must be considered.

Since gases only give up their heat by contact with solids, and the rate of exchange is proportional to the difference of temperature between the bodies in contact, in a cupola of any given capacity the smaller the amount of gas to be dealt with the greater the extent to which its temperature will be lowered. Obviously, all air that enters the cupola at any point must be actually burnt.

Undeveloped Heat

As pointed out, carbon in burning to the monoxide generates less than a third of the total heat of combustion. The loss of heat due to this cause is obvious. Its presence may be due to an insufficient air supply; bad distribution owing to certain areas of the furnace not receiving their proper quota while others receive an excess; cooling down of the carbon monoxide thus generated below the ignition point before it is mixed with the air intended to produce complete combustion. In any case, to generate the heat necessary to carry on the melting, an increased amount of coke must be burnt.

The relation of the height to diameter will determine largely the number of contacts which the gases in the ascending current make with the solid matter of the charge and thus the extent of the cooling effect it produces. All the heat abstracted will be carried downwards towards the melting zone and reduce the amount it will have to take up in that region, so that not only economy will be secured but the time occupied in absorbing it will be less; the melting will be quicker and the metal will be exposed for a shorter time to the action of the blast with consequent less alteration in the calculated composition of the metal.

Effect of Gas Velocity

The castings soften as the blast pressure rises. In comparing narrow and tall structures with others wider and lower it must be noted that for the same volumes of gases and weights of charge the velocity of the gas current in the narrower furnace reduces the time of each individual contact but increases the number. In the wider, the time of contact is increased, but the number is reduced. That the former condition is most efficient will be seen when it is remembered that gases are the worst conductors of heat, and when contact occurs the film in immediate contact has its temperature lowered by giving up heat, and that the heat from the remainder of the gas can only be transmitted through the cooled film, thus slowing down the rate of transference. It is due to this very largely that even when burning larger amounts of fuel the old-fashioned low cupolas do not produce metal as hot and fluid enough for the lightest type of castings. In some of the old cupolas, with a total height of 7 to 8 feet and tuyeres 22 to 26 inches above the bottom, the top of the bed frequently extended 15 to 18 inches above the tuyeres and thus left only 3 to 4 feet for the reception of the charge.

In modern cupolas a ratio of height to diameter of about 5 to 1 gives satisfactory results, as affording the greatest economy, without unduly increasing costs of construction and handling of stock. A further point is the possibility of the lodgment of the charge, especially in small cupolas, and the necessity of using bars to dislodge it. If the obstruction is low down the difficulty of removal becomes too great if the charging hole is high. A ratio of 4 to 1 is often maintained on this account.

The efficient concentration of the heat

will operate in every direction; less fuel burnt means also less air necessary, and less power for blowing purposes and most regular working of the furnace.

Tuyere Area

The rate at which the fuel is burnt and heat generated, which determines the melting rate in the cupola, is dependent on the quantity of air supplied in an efficient manner. In the older cupolas the tuyere area was far too small, and very curious conclusions were frequently arrived at. An increase of pressure produced better results. This was ascribed to the necessity of securing penetration of the charge by the blast, whereas its effect was mainly due to the increased amount of air so supplied, as well as its greater penetration. It will be seen that if a tuyere opening into the larger chamber of a cupola is incapable of supplying sufficient air to extend over its superficial area its upward movement will commence near the sides of the chamber, leaving the middle unaffected, but with a larger volume its effect will penetrate more deeply into the mass, the resistance offered to its lateral as compared with its vertical movement determining its relative movement in the two directions. An increase in pressure will, by driving it forward, overcome the natural tendency of the air to rise due to becoming heated, and the less close packing of the material in contact with the furnace wall.

The best results must ensue when an equal quantity of gas is diffused over the whole sectional area of the furnace and rising regularly through the stock in the furnace. Any tendency of the air to creep up the sides in large volume will, unless the bed is deep, produce cooling and a tendency to hanging of the charge.

It follows, since a definite amount of air is required to burn coke used in melting, that for the admission of a given quantity of air at a given pressure, a certain tuyere area is necessary; that the minimum pressure necessary to secure the uniform diffusion of the gases will vary with the diameter of the furnace and the rate of supply must vary with the depth of the stock above the tuyeres, since that will determine the frequency and period of contact.

From the latter conclusion it would appear that for every cupola, in order to get the most economical results, there would be a different ratio, but if the height is sufficient to secure the cooling of the gases, a further increase has little or no effect unless it is such as to materially increase the resistance offered to the free passage of the gases through the contents of the furnace. It may, therefore, be eliminated and its application limited to those older and lower furnaces now rapidly disappearing.

This consideration, however, affords thought on the value of adjustable tuyere areas such as are provided by reducing tuyeres or even by cupolas having upper rows provided with doors for closing them when necessary. The provision of adjustable tuyeres is of advantage on experimental cupolas or on those dealing with material liable to great fluctuations in size and tendency to pack in the cupola, or where great fluctuations in the blower are likely to occur through lack of power, etc.; but on those running on uniform material under constant conditions adjustable tuyeres afford no advantages other than those of emergency.

The other factor controlling tuyere area is the shape. The volume passed by tuyeres of equal area but of different shapes, will vary with the friction encountered, and as

$$p\ a = K\ S\ v^2$$

where p = pressure, a = area in square feet, S = area of surface, v = velocity, and K = coefficient of friction. It follows that the friction will vary with the size of bounding surface, whether round, square, triangular or flat, and an increase in area in these proportions will be necessary in passing from one form to another if equal amounts of air are to be delivered under the same conditions of pressure.

The results of experiments carried out to determine the best ratio of tuyere area to sectional area must consequently vary.

Bellamy arrived at a ratio of $\frac{1}{1.92}$

The following experimental results representing the conditions finally decided on may be compared:

	No. 1. Inches.	No. 2. Inches.
Diameter at tuyeres.....	32.5	47.0
Diameter, widest part....	40.0	61.0
Diameter of tuyeres.....	4.5	5.25
No. of tuyeres.....	3	4
Height tuyeres to stage..	96	84
Height bottom to tuyeres	28	28
Blast pressure	20	30
Sectional area at tuyeres	17.4	20
Tuyere area	1	1
Volume of air per square inch per second.....	1.2	1.44
Area fed per square inch tuyere area	14.5	14

The smaller cupola was melting from 2.5 to 3 tons per hour and the larger 5 tons, with a coke consumption (without bed charge) of 1 to 7. Under the conditions of working this was good. It will be observed that the average of the sectional areas of the two, namely, 18.7, compares favorably with the former determination. Neither of the cupolas was as high as it would be advisable to make them if new ones were being installed, and in that case probably a nearer approach to the figures might have been made.

In existing cupolas the throttling of the blast by tuyeres too small for the purpose is often a source of delay and loss. On the other hand, too large a tuyere reduces the blast pressure below the limit of efficiency.

Few points in connection with cupola construction have received more attention in recent years than the number, shape and position of tuyeres. Each inventor has endeavored to secure the most perfect distribution and complete combustion. Apart from the question of pressure, the position of the tuyeres exerts a great influence and the advantage of using a number of tuyeres is so fully recognized as to require no comment. Special shapes may be divided and classified as elongated deep tuyeres, flat tuyeres, or a combination of the two. The reducing tuyeres of the Truesdale and Laurence type, as well as vertical slot tuyeres, belong to the first class. In the second class, sheet blast, oval, expanded, Blakeney, MacKenzie, Whiting, and many others are included, while the triangular, reversed T and the horizontal and vertical slot combination belong to the third class. Some of these, like the Blakeney, are intended to give certain directions—more or less important to the blast—but it is first necessary to consider them as mere air inlets.

In tuyeres of the first and third types, the objects aimed at were to supply air in such a manner as to secure complete combustion and to prevent bridging of the furnace, the upward extension of the tuyere being intended to supply air to consume the CO generated by the air entering by the lower portion, which in many cases was wider and supplied the bulk of the air. How far this is possible is very doubtful. The conditions previously considered will show that at the ignition point of carbon monoxide, coke itself would burn in a supply of air, and the heat produced by the carbon monoxide burning would increase the temperature, thus making it burn more readily. Further, the upward extension of the tuyere—some of them were 12 inches high, and in a few cases 16 to 20 inches high—would mean an extension of the coke bed above that level and correspondingly higher position of the melting zone, with a reduction in the effective depth of descending charge cooling the gases. The successful results obtained by some of these arrangements must be attributed to a better supply of air and the greater number of tuyeres giving a better horizontal distribution of blast, rather than to their upward extension.

Flat Tuyeres

The advantages of flat tuyeres lie in the fact that to secure an adequate tuyere area they must extend round a greater part of the circumference and secure a better and more even distribution of air.

The nearer they approach to a continuous slot the more perfect this becomes. The consequent narrowing of the aperture brings the zone of active combustion and the melting zone lower in the furnace, thus tendng to enconomy. Whether any specialised form has distinct advantages will depend on the blast pressure. An expanded tuyere widening towards the furnace could only be effectively used with a higher blast pressure than would be required by a straight slot or by one which is contracted towards the interior of the furnace.

Position of Tuyeres

Lowering the position of the tuyeres and diminishing the thickness of the coke bed increases the effective height of the cupola and tends to economy.

The height of the tuyeres, as the main factor in determining the position of the melting zone, has also a marked influence on the practical working of the cupola, such as its freedom from hanging and bridging. Other factors that enter into the consideration are the pressure and volume of blast, as they affect the amount and upward velocity of the air current. Increased quantities absorb more heat from the material immediately in front of the tuyere and produce a greater cooling effect. Whether this causes the hottest zone to be somewhat raised or not will be influenced by the actual amount blown in. If this exceeds the required amount or the amount that can be usefully employed in combustion under the working conditions the zone will be raised, but if the increase does not exceed this quantity then the amount of fuel usefully burnt in the region of the tuyere will be increased, the amount of heat generated greater, more rapid melting of the stock, accompanied by a quicker descent of the charge, with a corresponding greater cooling effect on the gases, and greater concentration of heat in the melting zone with the lowering of the region.

There is, therefore, considerable justification for the provision in cupolas of means of adjustment of the tuyere position to suit all the exigencies of any particular case, but once that position has been found, unless some departure is made from the existing conditions, there does not appear to be any further reason.

In actual working, pressure and volume of air should be maintained as nearly constant as possible and the shape of the furnace should not be altered or its capacity increased or diminished by changing the thickness of the linings, as sometimes advocated, nor should the daubing up of the walls be so carried out as to alter the diameter by giving a smaller diameter at the beginning of its use to allow of greater wear and tear before daubing up again —a variation sometimes amounting to 4 inches. Such a variation on a 30-inch cupola means an increase of 15 per cent on the sectional area of the cupola.

The distribution of the tuyeres round the cupola includes the consideration of the employment of one or more rows. From the consideration laid down at the commencement, the following deductions may be made.

Since the concentration of the heat low down in the furnace gives better facilities for cooling the gases, and this can be best effected by placing the tuyeres low down, if it be possible to supply a sufficient amount of air and properly distribute it by a single row of tuyeres, the best results, economical and practical, will be secured. But where a greater amount than can be properly distributed by a single row is employed, in order to secure rapid melting, two or more rows may yield better results. The advantage, if any, that is secured results from increasing the *volume of the furnace* in which active combustion is proceeding, and necessitates increasing the depth of the coke bed to compensate for a raising of the level of the combustion zone. The extent to which it is effective or otherwise will depend on the character and disposition of the coke in front of the tuyeres. If the bed be more readily penetrated, distribution will be easy and a single row of tuyeres effective. When a double or triple row of tuyeres is used, the disadvantages alluded to may be minimized by giving the upper rows such a downward inclination as will cause a concentration of the blast on a lower plane. How far this will be effective is influenced by the pressure and by the fuel, for it must be remembered that the penetration and distribution are not such as would obtain in an empty furnace.

It will be inferred from the foregoing that where more than one row of tuyeres is necessary, the distance between the rows should be as short as possible.

Upper Row of Tuyeres

Upper rows of tuyeres are sometimes a source of trouble. If a lump of cold iron gets in front, bridging may quickly commence, and from the position of such tuyeres it is obviously more likely to occur, especially when the minimum coke charges are being employed. Hence the provision made in many cases of doors or dampers to the top tuyeres, at least, and the permanent closing of them by many foundrymen.

One advantage of a double row of tuyeres is that it provides the foundryman with a cupola having some reserve in its melting powers. A cupola of adequate diameter with adjustable tuyeres and an additional upper row which may be closed at will, may be used as a single-row furnace with a thick lining for general purposes, but on occasion the increased thickness of lining may be removed and the additional tuyeres called upon. This would necessitate the existence of sufficient blowing facilities to meet the increased demand for greater volumes and pressures.

Internal Shape of Furnace

Consideration of the internal shape of the cupola will be restricted to the internal lines of the furnace, and the question of drop bottoms and other points mainly connected with facility of handling will be omitted except where they have a definite bearing on the efficiency of working. All makes of cupola may on this consideration be classed under three headings:

Straight shaft cupolas, with or without enlarged bottom reservoirs.

Cupolas contracted in the region of the tuyeres, (*a*) with straight shafts; (*b*) expanded shafts.

Cupolas with shafts tapering upwards.

The advantages or otherwise of these forms must be looked at from two points of view. Ease in handling, as well as economy, is important, and the shape probably exerts a greater influence on this than on the economy of melting.

Bearing in mind the modern method of charging and working a cupola, namely, the charging of the fuel and metal in distinct layers so adjusted that the top of the bed coincides with the top of the melting zone, the effect produced on the lining and the charges so adjusted that as the last portion of a charge melts at the level of the lowest point of the melting zone and the next layer of coke sinking just fills the zone so that the next charge of metal begins to melt at the top of the melting zone, it will be seen that success and regular working depend on the uniform descent of the materials, and if uniform distribution of blast be secured, a straight wall would insure this.

Any tendency of the blast to pass up the sides of the furnace as the result of the looser packing of the material in contact with it would lead to greater cooling immediately above the tuyeres, although a greater amount of combustion might result at a higher point in virtue of the increased amount of air traversing that part of the furnace. In that event the melting zone would be raised at the sides and lowered in the center of the furnace, while the gases at the sides would be less efficiently cooled and the metal would not be preheated to the same extent. A slight increase in the thickness of the fuel layer at the sides, so as to provide

a somewhat larger amount to correspond with the increased quantity of air, would prevent it from burning away too rapidly and permitting the unmelted metal or slag to come down so far as to meet the cooling effect of the blast and getting in front of the tuyeres, thus setting up bridging. The practice often followed of heaping the metal to a greater extent in the center of the furnace provides this disposition of the materials, and no obstruction is offered to the regular descent of the charges.

Contracted at Tuyeres

In cupolas contracted in the region of the tuyeres, the object of getting the blast to the center of the cupola often given as the ostensible reason for doing it, is fulfilled, but, as previously shown, this can be effected by properly adjusting the blast pressure to the diameter of the furnace, and any real advantage must be looked for in another direction. Since the value of any contraction, except possibly in cupolas of the largest size, in supporting the weight of the contents may be passed over as unimportant, the only benefit possible would be that derived from securing a better distribution of the hot gases from the combustion region among the stock in the upper part of the furnace. It undoubtedly does this by delivering the gases into the center of the furnace and preventing them escaping up the sides. The early success of Ireland's cupola must be, in the author's opinion, attributed to both these causes. It must be remembered, however, that such narrowing of the cupola is practically reducing the cupola to one of the narrower dimensions, as all combustion and melting must be done in the contracted area.

Further, any contraction that is made must extend above the uppermost limit of the melting zone or the obstruction it offers (especially in those having no slope but simply built out in the brickwork) would be likely to lead to bridging by the melting material forming accretions whenever a slight or momentary cooling takes place. How far this is liable to occur will be familiar to those who have studied the effects of the lining getting out of shape, and the statement made by Kirk that in his experience with the MacKenzie cupola that "slag and cinder adhere to the lining over the tuyeres and become very hard and difficult to remove, and if care be not taken to remove them after every heat, it soon builds out, which reduces the melting capacity and increases the tendency to bridge and hang up."

Shaft Tapering Upwards

In cupolas with shafts tapering upwards, a further condition is involved. That the descent of the material is assured is palpable, but the contraction appreciable would have the effect of permitting the hot gases to come into more direct contact with the sides of the upper part and produce a greater heating effect. This, however, would in most cases be slight. The author knows of only one cupola in which this is carried into practice—the water-jacketed cupola of Gruelin, in which the radius increases by the thickness of the plates at each joint from the top downwards. In this cupola the effect of the greater heating of the sides cannot be gaged, as the circulating water prevents any undue heating.

Use of Plaster of Paris for Making Patterns

By W H Parry Jr

PLASTER of Paris now seems to be recognized as a standard material for use in the construction of patterns. When viewed from such a standpoint there are three things to consider: First, the length of time required to construct the pattern; second, the number of castings required; and third, the size and weight of the pattern. On account of the many uses in which it can be employed, no pattern shop should be without a barrel of plaster of Paris. There are several grades, ranging in price from one to five cents per pound, in barrel lots. A plaster should be secured that does not set too quickly, but when set, it should be hard, firm and close-grained. A plaster of this grade can be bought for 1¼ to 1½ cents per pound.

Up to the present time plaster has been used largely by metal patternmakers, and many patternmakers in wood have not taken kindly to the use of this material. They have ridiculed the workmen that have attempted to experiment with it, thinking perhaps that it would cut into their time. This it does, to a certain extent, but the patternmaker has been fortunate in that he has not been confronted with the many different types of labor-saving machinery that have been introduced in other trades. It is true that labor-saving machinery has been placed in the pattern shop, but it has not seriously affected the working time of the patternmaker. Plaster of Paris, we might say, has been one of only a few invaders in the pattern shop, and its use, when practicable, should be encouraged by the foreman, and the apprentices should be taught to handle it.

The Use of Cement

Cement is sometimes added to plaster to harden it, and I have heard it advised up to 50 per cent, but I would not go above 33 1/3 per cent; in fact I seldom use it at all, especially if the plaster has to be worked with the chisel.

When set fairly well, a good plaster can be worked by the patternmaker; it can be chiseled, nailed, drilled or sandpapered, and it takes shellac well. The first coat of shellac will not last long, but after the plaster has dried out it will take a fine shellac finish, yellow or black.

Plaster of Paris is used extensively in making master patterns, and also for making matches and in sweep work. In the jobbing shop plaster can be used to great advantage, especially on rush jobs. By using the old casting and plaster of Paris, much time can be saved.

Fig. 1 shows a casting used on an oil tank. We will assume that only one casting is required and that it must be finished at *F*. By the use of plaster of Paris in the casting, a pattern was made in an hour. A wood core first was turned up, proper allowance being made for a finish. A board about 8 inches square and 1 inch thick was made true on both sides to which the core was fastened by a screw. It will be noted that the wood core is tapered so that it will easily slip out the plaster and to facilitate drawing the pattern out of the sand. The entire piece is given a thin coat of yellow shellac and when dry, a good coat of sweet oil. This will allow the core to leave the plaster clean. The casting is then placed over the core on the bottom board, where it is set true with a circle 4⅜ inches in diameter described about the center of the board. Plaster of Paris is then poured between the casting and the wood core. The plaster in this case finds a good anchor in the threads that were turned in the casting.

Let the plaster set and then turn the piece over; remove the screw

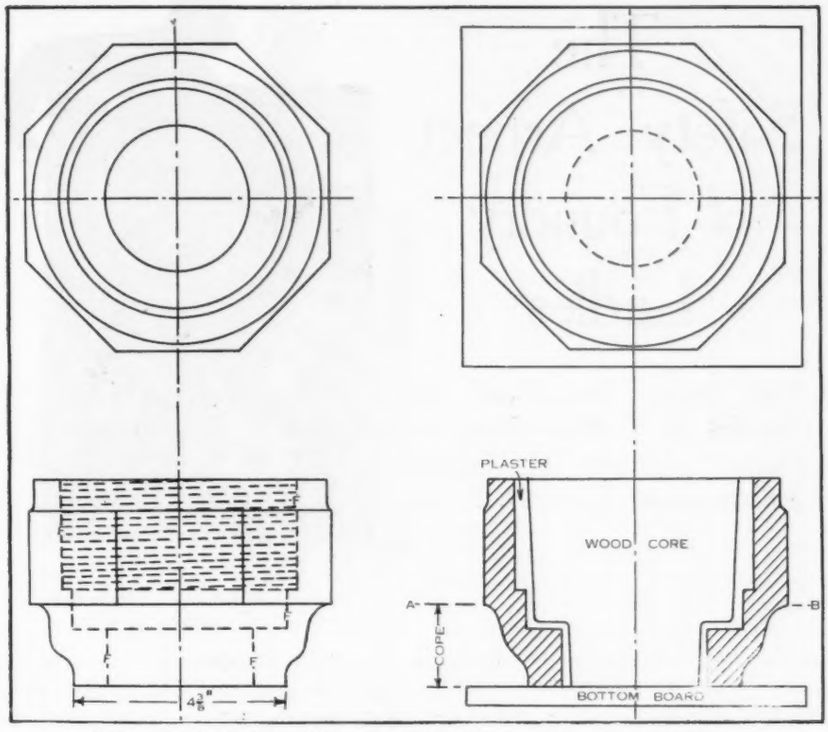


FIG. 1—PATTERN FOR CASTING USED ON OIL TANK

and bottom board and lightly tap out the core. This will leave a fine, smooth surface and the molder will have no trouble in drawing the pattern. He will part the mold on the line *AB*, Fig 1. Two holes may be bored in the cope side of the pattern to enable the molder to rap the pattern and draw it out.

Fig. 2 illustrates a chain or rope sheave which was sent to a pattern shop with a piece of the edge broken off, as shown. Finish was wanted on both sides of the hub. A piece of leather was placed around the circumference of the casting, spliced as shown, and fastened together by small staples or tacks. The leather piece can be fastened together before it is placed on the casting and made a trifle small so that it will fit snug. If the hole in the hub is plugged, a finish allowance for the hub can be nailed to the plug. Plaster of Paris can be poured into the space, *A*, and made smooth and even at the broken part of the casting when it has set. Similar work can be done on gears or sheaves from 6 to 12 inches in diameter. A single thickness belt around the circumference will give sufficient allowance for shrinkage and finish. Gears usually are finished on both sides and in such cases the leather should be ripped ¼-inch wider than the face of the casting. This can be done on the saw table by using the cross-cut saw instead of the rip saw. When placed around the circumference of the sheave or gear, the belt should be made even with the face of the casting on both sides. The plaster can be stopped off by clay or molding sand.

The foregoing are examples of rush jobs that often come into the pattern shop of a large manufacturing plant. Patterns of this kind should be numbered and stored away for future use.

Proportions of a Cupola

By W. J. Keep

Question:—We are contemplating the installation of a new cupola for melting iron for stove plate and we would like to know what should be the proper height from the cupola bottom to the bottom of the tuyeres. We would like to have information as applying to cupolas 42 inches and 45 inches inside diameter. What should be the proper number and area of the tuyeres?

Answer:—If you use coke for fuel the lower edge of the tuyere opening should be 12 inches above the sand bottom. The inside opening of the tuyere should be about 4 inches high and 16 inches wide. Next to the shell the opening should be about 7 inches square. You can locate six tuyeres of this size in a cupola lined to 42 inches and this would provide about 4 inches between openings. The walls should be ½ inch thick. You can vary these proportions, but you should have as nearly a continuous opening as can be obtained. The bottom of the tuyere should be inclined, being about ½ inch lower on the inside of the cupola to prevent iron or slag from running through this opening. Make a rod 2 inches in diameter at the bottom, tapering to ½ inch in diameter at the top and a trifle over 4 inches long and drive it in from the back nearly to the front of the tuyere to keep the top from sagging when hot. When melting iron for stove plate use only one row of tuyeres, making a slag tapping hole 4 inches below the bottom of the tuyere opening. Directly above the slag hole leave the tuyere openings about 8 inches apart so that the blast will not chill the slag. As to the area of the total tuyeres, get these as large as possible, maintaining the tuyeres at a height of about 4 inches. The coke in the cupola and the chilled slag will sufficiently decrease the size of the opening.

The Isthmian Canal Commission recently awarded a contract to the Ingersoll-Rand Co., New York, for furnishing three, large, direct-connected, electrically-driven air compressors of the duplex type. The combined capacity of these units will be 10,000 cubic feet. This machinery will be installed at the Balboa shops, where the compressed air will be used for general repair work in the shops and also on the new dry dock.

In the June issue of THE FOUNDRY, page 235, was published an article describing a wonderful Tropenas converter heat record. This record was made at the plant of the Sivyer Steel Casting Co., Milwaukee, under the supervision of John Gregson, foundry superintendent.

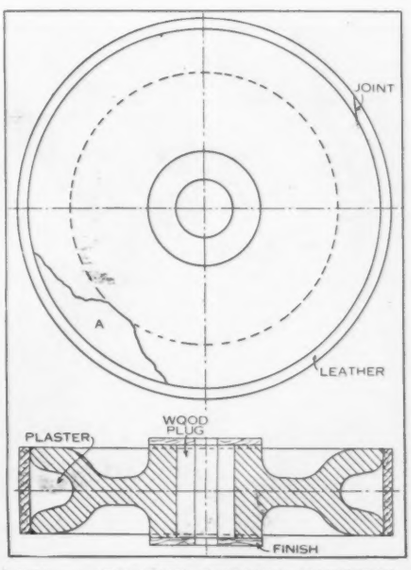
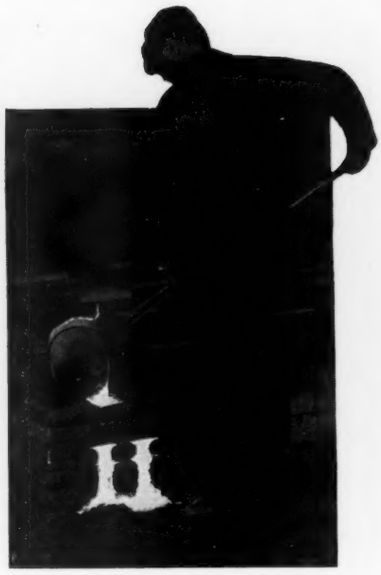


FIG. 2—BROKEN SHEAVE PATTERN REPAIRED WITH PLASTER

WRONG WAY OF POURING—FEET CLOSE TO MOLD, TROUSERS ROLLED UP, LACE SHOES

The Safety Aspect of Foundry Ladles

How Molton Iron Should Be Handled in Casting Shops to Prevent Accidents — Another Bulletin issued by the N. F. A.



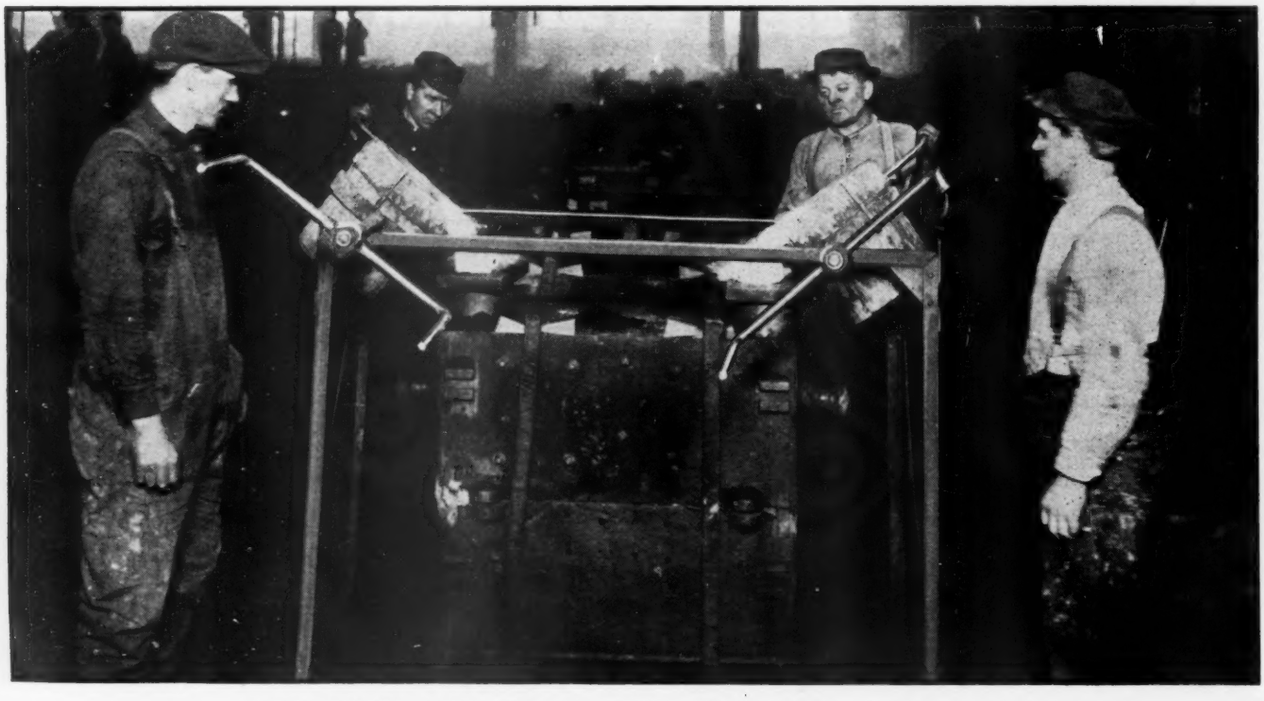
RIGHT WAY—FEET AWAY FROM MOLD, FOUNDRY LEGGINGS AND FOUNDRY SHOES

ANOTHER bulletin, in its magnificent campaign to reduce foundry accidents, has been issued by the Committee on Safety and Sanitation of the National Founders' Association. It is pointed out that the general hazards in the use of foundry ladles are so obvious that they usually are well guarded against. Unusual hazards, however, are apt to escape notice, and it is therefore necessary to prepare, inspect and handle foundry ladles with utmost care, to avoid a disastrous surprise.

To prevent premature tilting, all ladle bowls except single hand ladle bowls, should be so balanced on their shanks or trunnions that they will naturally remain erect, regardless of the amount of metal in them. A top-heavy bowl is a menace. On the other hand, an excessively bottom-heavy ladle throws unnecessary strain upon the operating mechanism and upon the operator himself, and makes smooth pouring difficult. Careful balancing is therefore important.

Ladle shanks must be amply strong. The strain is usually greatest at the joints, and these joints should be securely welded. Moreover, there should be regular inspection for flaws which may develop in the welds, or for other weaknesses caused by erosion of molten metal or by wear. Defective ladle shanks should be promptly removed from the foundry, to obviate their further use until repaired; discarded ladle shanks should be immediately scrapped. Ladle shanks should never be stored where they are exposed to weather and rust.

When practicable, single hand ladles should have their shanks securely attached to their bowls. While such ladles necessitate a shank for each bowl and require more room for stor-



LADLE HORSES FOR SUPPORTING BULL LADLES WHEN POURING HIGH MOLDS

WRONG WAY—LADLE IN FRONT, NO FENDER, NO LEGGINGS, TROUSERS ROLLED UP, LACE SHOES

age and for heating, they are safer than ladles with detachable bowls, which are apt to slip out of their shanks when upturned. The linings of detachable bowls, moreover, are liable to be cracked when the bowls are jammed into the shank rings. If, however, detachable bowls are used, there should be a wedging fit in the shank ring, and so balanced as to prevent, as far as possible, a tendency of the bowl to fall out when tilted.

Shanks for bull ladles, with a rigid fork at one end and a swivel fork at the other, carry and empty the bowl more evenly and with less chance of slopping over than when both forks are rigid, as the man on the swivel end does not interfere with control of the ladle by the man at the rigid end. The bowls of bull ladles should be secured to their shanks by flat iron or round iron straps.

Shanks with one end plain and designed solely for reservoir use, should not be used for carrying, as the plain end does not afford a proper grip; if a carrying bar is used with it, the bar is apt to slip off.

Gearing

Ladles equipped with direct acting spur gears are the cheaper type of geared ladles and provide most rapid operation, but the entire and excessive strain of controlling the flow of metal must be borne by the operator, whose unsteady control produces a more turbulent stream than when operation is through a train of spur gears or through a combination of spur or bevel gears with worm gearing.

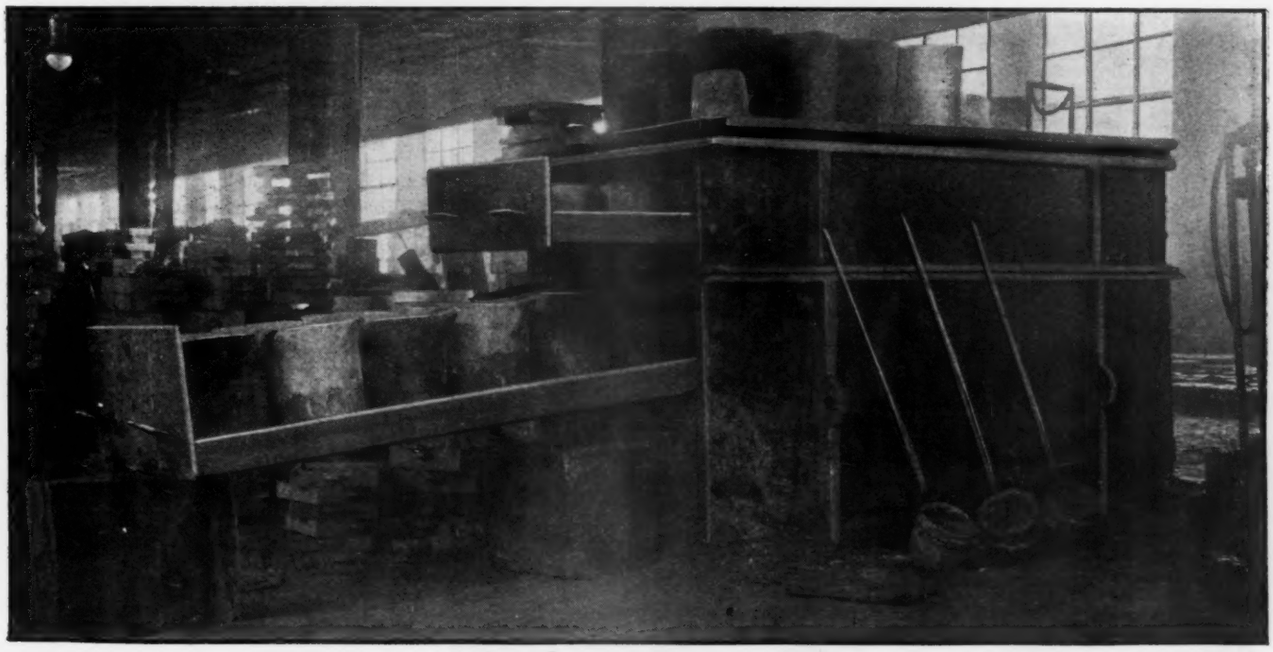
Whatever the form of gears employed, it is obvious that the small and rapid pinions and worms wear most quickly and that safe control depends largely upon these small members, which should therefore be regularly inspected and kept in good condition.

The use of machine-cut gears will add to the smoothness and safety of geared ladle operation; it is further advisable that the design of all worms and pinions should allow at least two teeth to be in mesh at all times, to provide smooth operation and to guard against accident in case one tooth should break.

RIGHT WAY — LADLE IN BACK, WITH FENDERS, FOUNDRY LEGGINGS AND FOUNDRY SHOES

The gearing should be so arranged that hand wheels on all ladles in the shop will turn the same way when pouring; otherwise the operator is apt to become confused and tip the ladle in the wrong direction.

The entire operating mechanism is subject to extremes of heat and cold; expansion, contraction and other strains of service tend to loosen up keyways, set screws, pins, spring cotters, bolts and rivets, with the result that gears, trunnions, hand wheels



AN OIL-FIRED LADLE HEATER

WRONG WAY—CUTTING-IN FROM BACK OF STREAM

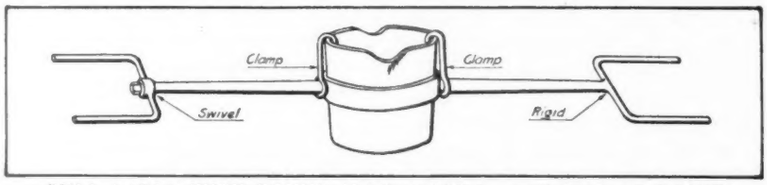
and operating handles or shanks are apt to become disengaged at a critical moment. Where, due to their construction, gears, hand wheels or trunnions are liable to become loosened and slip from their shafts, the keys can be spotted to receive the points of pointed set screws; sometimes the hub and shaft will admit of the use of a tapered pin, one end riveted over, or set screws can be provided with jam nuts and pins can be riveted in place.

The gearing should be protected by covers which will prevent metal splashing upon the teeth, which may thus render the ladle inoperative, or cause the teeth to break when force is applied to tip the ladle. When they, however, completely enclose the gears, these covers should be easily removable, to encourage frequent inspection of the gear mechanism.

When ladles are purchased, care is usually taken to provide amply strong bails and trunnions. Constant wear, however, especially where the crane hook engages the bail, gradually weakens the bail at that point, a condition which is apt to be overlooked until too late. It is better to err on the safe side by replacing such bails too early than to invite injury by their neglect.

Latches, pins or some other method should be provided to secure ladles in an upright position when being carried on cranes, monorail systems, ladle buggies, or even when resting on ladle horses. This is a precaution which has frequently prevented rocking or upsetting of ladles.

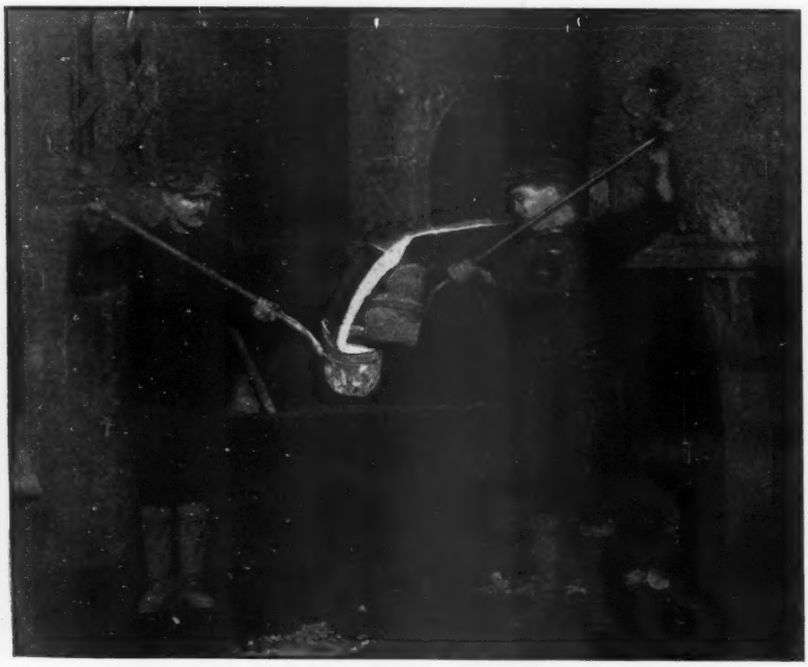
It is important that ladle lips be so designed that the flow of metal will concentrate into one smooth stream, instead of in wide, turbulent or divided streams; also to prevent backing up and overflow of metal from the ladles' sides.



BULL LADLE WITH ROUND IRON CLAMPS. ONE END OF SHANK SWIVELED

It is advisable that a capable, experienced man should line all foundry ladles, instead of allowing each molder to line his own. The former has the advantage of greater experience and has more interest in safe ladles than in extremely light ones, while the molder's skill is in making molds, not in lining ladles, and he is apt to line his ladles too thinly in order to secure greater capacity and lightness.

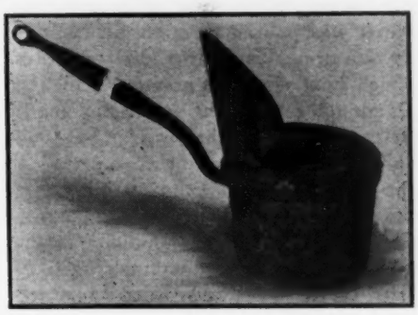
Drying of ladles must be thorough; otherwise contact of molten metal with the moist lining may cause an explosion and scatter the metal. While in some foundries it may be impracticable and undesirable to dry large ladles except by wood fires, or by drying torches, it is becoming more and more the practice, even in small plants, and especially in connection with single hand ladles and with bull ladles, to dry them in an oven or over special ladle heaters. In many plants, ladles are dried in a large core oven; where crucible furnaces are available, the heat from these is often



RIGHT WAY—CUTTING-IN FROM FRONT OF STREAM

utilized. In other foundries special ovens have been built. In some small foundries ladles are dried over trough-like, cast iron, fuel boxes.

When lining and drying of ladles are under the control of one man, a better opportunity is afforded to inspect all ladles thoroughly every day.



HAND LADLE WITH FENDER

Inspection for cracked or thin bowls, loose rivets, eroded shanks, defective welds, imperfect balancing, as well as daily attention to safeguarding the gear mechanism, is thus concentrated under one man's watchful eye. Moreover, the foreman himself can give better oversight to this department of the work when one man, not a score or more, is delegated to the task. This method also tends to insure storage of all ladles, large or small, in a dry place, instead of in damp corners or upon wet sand where they are apt to rust. Large ladles which remain unused for long periods, should be stored upon supports to provide air space and prevent absorption of moisture from the ground.

It is further advisable that the foreman or some one delegated by him, should keep a watchful eye upon ladles while in service, to detect thin spots or breaks in the linings; such defective ladles must be immediately emptied and discarded until relined.

The use of sulky and buggy ladles is limited to level floors or industrial tracks. Their wheels and bearings should be kept in smooth and easy running order, as a wobbly condition invites a spill, and difficult movement causes exasperating and dangerous delays. The possibility of a wheel slipping off its axle should be well guarded against.

When filling hand ladles from a continuous stream of metal, excessive spattering will be avoided by cutting into the stream from the front, instead of from its back, and no ladle should be filled so full that it will easily slop over when carried.

The bail of a crane ladle should be raised to a vertical position and latched in place, and the crane hook should hang directly over it, before it is lifted, to avoid a dragging action which might tip the ladle when being hoisted. An iron rod, suitably bent, is frequently used to guide the crane hook into place when it engages the ladle, allowing the workman to stand in a safe position while guiding the hook.

Carrying and Pouring

A new man should not be allowed to carry ladles of molten metal until he has been around the shop for several weeks and has become familiar with foundry conditions and hazards. The pouring of crane ladles should be intrusted to experienced men only, as a new hand is apt to tip the ladle too fast or in a jerky manner.

In carrying a hand ladle, it is advisable to turn the knuckles of the lower hand forward, so as to keep the bowl behind the workman as he walks.

In order to protect hands and legs, a tin sheet iron fender, about 10 inches wide, and projecting about 6 inches above the bowl, should be fastened to hand ladles where the shank joins the bowl.

In some foundries, where many men are carrying hand ladles at the same time, it has become the practice to pass each other on the bowl side. This rule prevents confusion; moreover, collision with the ladle bowl does not cause so great a splash of metal as collision with the ladle shank handle.

Men carrying bull ladles in pairs should be about the same height, so as to carry the ladle horizontally; workmen passing them should keep to the right.

When pouring, the pourer should keep his feet as far away from the mold as convenient, to avoid a burn

GEARED CRANE LADLE WITH GEAR COVER

in the event of a runout.

Under some conditions, especially where large quantities of high molds of uniform height are regularly poured from bull ladles, safety as well as ease in pouring are gained by using portable horses which straddle the molds, and on which the ladles rest while they are being emptied.

Iron for Piston Rings

By W J Keep

QUESTION.—What is the best mixture of iron to use for piston rings? Some time ago we made these castings from iron of the following composition: Silicon, 1.60 per cent; sulphur, 0.056 per cent; phosphorus, 0.595 per cent, and manganese, 0.60 per cent. The rings, when spread, did not return to their original form, indicating a lack of resiliency. In a carload of automobile scrap we found some piston rings which broke when the resiliency test was applied to them. The composition of these rings follows: Silicon, 2.37 per cent; sulphur, 0.099 per cent; phosphorus, 1.056 per cent, and manganese, 0.48 per cent. In a handbook for machine designers, a suggested analysis for piston rings follows: Silicon, 1.50 to 2 per cent; sulphur, under 0.08 per cent; phosphorus, 0.30 to 0.50 per cent, and manganese, 0.40 to 0.60 per cent. There is no very great difference between this analysis and that of the rings we made, although the phosphorus in our iron may be a trifle high. How can we change this mixture, preferably by ladle additions, so that the piston rings will have greater resiliency?

Answer.—On page 145, Vol. 19, of the Transactions of the American Foundrymen's Association, J. J. Porter gives the following four analyses of piston ring mixtures:

1.—Silicon, 1.35 per cent, and manganese, 0.40 per cent.

2.—Silicon, 1.60 per cent; sulphur, 0.08 per cent; phosphorus, 1.15 per cent, and manganese, 0.35 per cent.

3.—Silicon, 1.50 to 2 per cent; sulphur, 0.06 to 0.08 per cent; phosphorus, 0.40 to 0.60 per cent; manganese, 0.45 to 0.60 per cent; combined

carbon, 0.45 to 0.55 per cent, and graphitic carbon, 3.50 per cent.

4.—Silicon, 1.50 to 2 per cent; sulphur, 0.08 per cent; phosphorus, 0.30 to 0.50 per cent; manganese, 0.40 to 0.60 per cent, and graphitic carbon, low.

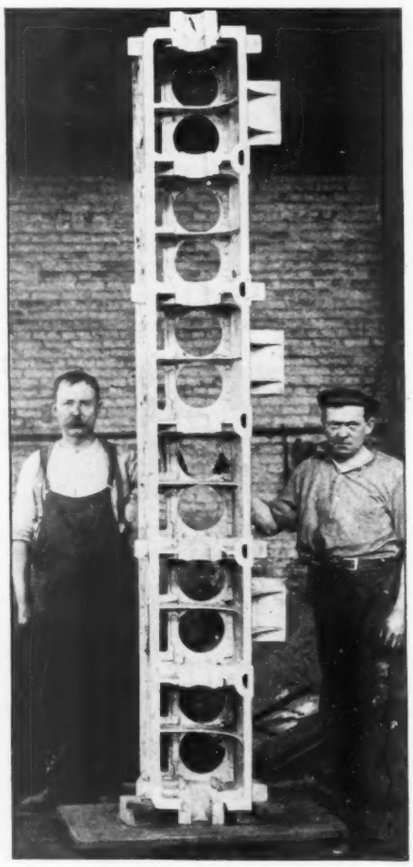
The foregoing analyses presumably represent satisfactory ring mixtures and the differences in their composition are undoubtedly due to the fact that they were of a different size before machining, or perhaps in some cases they represent ideal mixtures made by chemists. If the castings are made nearly the size of the finished ring (the size should be given in the foregoing analyses), the composition would indicate the proper mixture, provided the ring was satisfactory. If the casting was a cylinder slightly thicker than the ring from which the ring was cut, the composition should be quite different to produce the same characteristics. The composition for rings for a marine engine piston would contain considerably less silicon than if for rings for automobile pistons.

In applying analyses, the size of the casting for which the mixture is designed must be adhered to. If a larger casting is made, reduce the silicon, and vice versa. The sulphur acts the opposite from silicon, therefore you can vary either, or if the sulphur is constant, reduce the silicon in your first analysis to approximately 1.50 per cent and you will obtain the desired composition after a few trials. Any change in your pig iron or scrap may cause trouble. With so sensitive a mixture as that required for piston rings, it would not be advisable to make ladle additions. With an iron running uniform and by ladle additions, you can change small quantities of iron for special purposes, but the results are uncertain for accurate work.

The carbons play an important part and they will vary greatly if the amount of scrap used is changed. It is not practicable to vary carbon because it varies in the pig if the furnace changes in temperature. If you use one grade of coke and are careful to have the sulphur uniform, the silicon will have to be the sole regulator. To soften the mixture you can add a percentage of 50 per cent ferrosilicon in the ladle. To harden you can add sulphur to the ladle, but this element is not taken up uniformly and this method is not satisfactory. Machinery steel punchings, if not too large, will melt in the ladle and will give good results, or steel can be charged in the cupola. Tool steel, consisting of old files or tools, will melt more easily than the punchings mentioned. Such additions will decrease the percentage of all the chemical elements. An excellent way to close the grain and to increase the resiliency without changing the chemical composition is to charge in the cupola, clean cast iron turnings or borings in a wooden box made of 1-inch lumber. This box should have a capacity for exactly 100 pounds of borings. After nailing on the cover the box with its contents should be charged in the cupola and it should be counted as 100 pounds of scrap. The results will be surprising and very satisfactory. You can utilize steel borings in the same way, but you cannot employ them for the same purpose as cast iron borings.

A Large Aluminum Crank Case

Two of the largest aluminum crank case castings ever made in the Cleveland district recently were turned out at the plant of the Standard Brass Foundry Co., 1831 Columbus Road,



ALUMINUM CRANK CASE FOR 12-CYLINDER ENGINE

Cleveland. They form the bases for two 12-cylinder marine gasoline engines which are being built by F. S. Dusenberg, of Des Moines, Ia., for the new hydroplane, Disturber IV, which will be raced this summer by James A. Pugh, commodore of the Columbia Yacht Club, Chicago. Each casting, which weighs 365 pounds in the rough, was molded in green sand in an ordinary flask, using a wood pattern. The pattern was split through the center, the crank case being molded on its side. Six gates entered the mold along one side and the metal was poured through six runners at one time, using No. 100 crucibles which hold about 90 pounds of melted aluminum each. The mold was made by two men and a helper in a day and another day was required to trim off the sprues and clean the casting. The Standard Brass Foundry Co. makes a specialty of heavy and difficult aluminum and brass castings, particularly crank cases and other parts for marine and automobile engines.

Hard and Soft Castings

Question:—We are presenting herewith two analyses of radiator castings and we wish that you would kindly advise us, from your experience, the kind of iron each will produce, that is, whether soft, hard, brittle, etc. The analysis of the castings recently made follows: Silicon, 2.03 per cent; phosphorus, 0.561 per cent; sulphur, 0.077 per cent, and manganese, 0.65 per cent. Analysis of old castings: Silicon, 1.67 per cent; phosphorus, 0.65 per cent; sulphur, 0.099 per cent, and manganese, 0.50 per cent.

Answer:—From a chemist's standpoint, there are two causes for hard iron, namely, low silicon and high sulphur. The variations in phosphorus and manganese are too small to affect the results. For this reason the old castings should be harder, but there should be very little difference as to brittleness or grain. From the manner in which you have propounded this question, it is apparent that the new castings were the harder of the two and you would like to know the reason why the physical characteristics do not follow the chemical composition. The chemist would be correct if he would state that your analysis did not go far enough. You should have determined the total carbon, as well as the combined carbon, and the percentage of these would show which is the hardest. If the total carbon is below 3.25 per cent and the old castings contained more than this, this would indicate that there was not sufficient carbon in the new castings on which the silicon could act as it was expected. If chemical composition does not explain the condition, this may be due to the way in which the iron was melted.

How to Anneal Gray Iron to Obtain Best Results*

The Practice in an English Plant Devoted to the Manufacture of Textile Machine Spindles

By Robert Buchanan

THE cast iron used in spindle making is always annealed, and is known under the generic name of *black iron*. That cast from part hematite, or from irons with about 1 per cent phosphorus, exhibits a fine, velvety fracture after proper annealing. In such a case there is practically no combined carbon present, all the carbon being in the form of graphite and annealing carbon. It is this complete separation of the carbon which principally gives the iron its velvety appearance when broken. One firm which produces these castings states that they may be machined at 600 feet speed per minute. In a good sample of this kind I have cut off a small paring with an ordinary pocket knife. I am aware that some makers use annealed castings made from their ordinary mixtures. These are not so dead-soft as the true *black* iron, and do not machine so easily and quickly, but they have undoubtedly more wear in them; that is, they have a longer working life. Naturally, firms which are spindle-makers only are more concerned about the speed of production than about the after life of the spindle. I have, however, heard complaint made that the spindles can be too soft from the users point of view.

Analysis

An iron suited for these castings and combining the best average qualities for rapid production and long life work will approximate to the following analysis:

		Per cent.
Silicon	not exceeding	2
Phosphorus	not exceeding	1
Manganese	not exceeding	0.85 to 1
Sulphur	not exceeding	0.80
Total carbon...	as high as possible.	

The annealing is for the purpose of changing into the form of annealing carbon, all the combined carbon present in the casting as originally cast. One could probably do that without annealing, by the use of high-silicon iron, say, 3.25 to 3.5 per cent, but such an iron would be deficient in total carbon. Partly from this cause, and partly from the fact that such a percentage of silicon would itself conduce to a harder product, the resulting iron, even when annealed, would not be so soft as one wherein the silicon was at the normal amount of 2 per cent. In short, the silicon should be present only to such an amount as will make certain the castings will be gray when cast.

The percentages of phosphorus, manganese and sulphur given above are practically neutral, but with a tendency to increase the wear of the metal. Of the molding of the castings little need be said. They present no difficulty unless it be in the case of long collars, and even in this case it is long cores of small diameter which present the difficulty. In the finished spindle there must be absolute balance, and for this they are carefully tested before being passed; so a thick and thin side on any casting at once condemns it. I have been informed that there are always plenty of orders for anyone who can tackle long collars successfully.

Annealing Cans

The annealing cans into which the castings are packed, are best cast of white hematite or other metal with a high melting point. In the "Black Country" they have also usually a large proportion of waste malleable castings melted along with the hematite.

These cans retain their shape well considering the service they do, and are still white when broken up at the end of their service. Sometimes a round can may be beaten oval before it will break. When being made they are cast in open-top molds made in sharp sand.

When castings are long the can is lengthened by means of a ring or bottomless can of similar material being placed on top of a can having a bottom. In some places the cans have no bottom cast on, but use loose bottom plates which rest on a ring cast inside the can. By this means any height of can may be built up, and by putting the top can with an internal ring at top, one of the loose plates can be used as a cover, and so luted on with fireclay. The annealing cans are of varied shape; some firms have them round, others rectangular, and in one case I have seen them oval.

When the cans are large, snugs or swivels are used by which they are withdrawn from the annealing oven by means of tongs 10 or 12 feet long, mounted on a pair of wheels. The tongs swivel on the axle on which the wheels are placed. When annealing ovens are continuous in action, these tongs are necessary for the withdrawal of the cans. The tongs are run up to the oven, the ends put under the snugs or swivels on each side of the can, and so the can is withdrawn. On oval cans there are two swivels on each side, each being similar to those on a flask. This allows the can to be balanced during withdrawal. The cans sometimes have lids which are luted on with fireclay, in other cases they are left open-topped. In the case of non-continuous annealing ovens, these are entered when they have cooled down sufficiently, and the cans and their contents carried out by hand.

Various packing materials are in use. Small gas coke which has passed through a quarter-inch riddle is one. Others use cast iron borings. In one case I found a mixture of cast iron turnings and red hematite ore was being used. This was a wrong material. It was thought that because red hematite ore was being used when annealing malleable iron castings, therefore it was a suitable material in which to anneal these castings; but the fact was overlooked that with the castings now being considered retention and not lessening of the carbon was desired. The sole object in packing the castings is that they may not twist or warp during the anneal. Long castings should be placed vertically in the cans.

When used as a packing material, small coke sags under heat more than do cast iron turnings or borings. This induces warping of the castings, especially if the oven has been over-heated.

Annealing Ovens

These may be divided into non-continuous and continuous. In the non-continuous oven the cans are allowed to cool down in the oven. This is the ideal way to get dead-soft castings. These ovens may be, and usually are, in a battery of five or six, connected by individual flues to one central chimney stack. The ovens are known as 25-*can ovens*, or 40-*can ovens*, according to capacity. The firegrates are on each side of the oven, are sunk about 4 inches below the floor level, are 12 inches wide, and extend the whole length of the oven. That is, the firegrate is about 9 feet long by 1 foot

*Presented at the annual meeting of the British Foundrymen's Association.

wide. Before the cans are put into the oven lump coal is piled about 4 feet high over each firegrate. This is all the fuel used; there is no subsequent firing. The fire doors are used only to start the fire and to remove clinker, etc., after the oven has cooled down. When the two walls of coal have been built the cans are placed in position. As this is done by hand, the highest point of the roof inside does not exceed 6 feet 6 inches to 7 feet.

The cans, which are ready packed with castings embedded in coke dust or cast iron borings, are placed along the sides next the coal, and at the end furthest from the entrance. This is continued until the oven holds as many cans as it will contain. The opening is now bricked up loosely, and daubed with loam or mud. About 9 inches above the floor level a brick is left sticking out so that it may be readily removed when the soaking begins. In about 12 hours from lighting the fire, the coal on each side of the oven is a glowing mass, and all visible smoke has gone. The interior of the oven is now a bright red, but the heat has not yet penetrated to the centre of the bottom cans. The soak is accomplished by withdrawing the brick which was left sticking out when the opening was built up, and closing the damper in the flue which leads to the central chimney stack. After soaking for 10 or 12 hours, the brick is replaced and the whole oven allowed to cool down. In 48 hours or so after the coal is lit the bricks closing the entrance to the oven are taken down, and the cans are withdrawn and emptied.

Continuous Annealing Ovens

There is no definite type of continuous annealing oven. They have this in common that only one row of cans is annealed at one time. The fire is at one side only in most cases, and the flames enter the oven through holes or ports in the wall, and leave the oven by similar ports in the opposite wall. Sometimes the flames are led to the flues through holes in the floor of the oven. The length of time the cans are kept in the oven depends upon the size of cans used. When the cans are considered to have been thoroughly heated through, the brick-lined door (or doors) is opened, the cans withdrawn, and others placed in the oven.

It is obvious that cans which are allowed to cool in the open do not get so good a chance of producing soft castings as do those which cool within the oven. Neither do they have the important advantage of the thorough soak possible in the non-continuous type of oven.

The object of the annealing is obviously to change the combined carbon into the form of annealing carbon, and thereby make the casting still softer than it was originally. It will be admitted that with a normal amount of silicon, say 2 to 2½ per cent, there is certain to be an appreciable amount of combined carbon in the castings. The smaller or thinner the castings are so will the amount of combined carbon be increased. The annealing is required to decompose this compound of iron and carbon into iron plus free carbon. That is what takes place when the annealing is perfect.

Hard Skin on Annealed Castings

I now come to a consideration of the matter which has caused this paper to be written. Occasionally it is found that during the course of the annealing the castings have acquired an exceedingly hard, white skin which no tool will touch. The interior of the casting is quite soft, but that is of no use if one cannot get through the hard, outer skin. That this is not a small matter is evidenced by the fact that I have seen a 30-ton heap of such castings, none of which could be machined. It is also within my knowledge that this hard skin causes serious loss to several producers of these castings at the present time.

As the outside of the castings could be readily filed before the anneal, and could not possibly be filed after the anneal, it was obvious that the hard skin was acquired during the annealing. It has been suggested to me that this hard skin may be due to oxidation, but there cannot be oxidation of a casting perfectly covered with coke. If the coke sags sufficiently to expose the casting to the flame and gases of the oven, the casting becomes oxidized, but the oxide is red. Neither am I aware of any oxide of a metal which is harder than the metal itself. Neither have I discovered yet a white oxide of iron.

A consideration of the whole circumstances brought me to the conclusion that the hard skin was brought into being by the agency of sulphur present in the packing material. This was confirmed by analysis of the small gas coke which was being used for this purpose. The sulphur contents approximated 2½ per cent. This sulphur was undoubtedly in greater quantity than what was originally present in the coke. The increased sulphur was obtained from the flames which fill the oven. It is well known that iron and steel take up sulphur from sulphurous flames and gases. Thus, whether cans are covered with lids or not, sulphur can be passed into the charge inside. The fact that the cans, white iron originally, remain white after many times annealing, shows that a cause is constantly operative to keep them white. It has not come within my observation whether cans which are originally gray iron become white under annealing conditions.

The deduction that sulphur was the cause of the trouble was proved to be correct by the hard skin not appearing when the packing material was changed oftener. It did not get the opportunity to become surcharged with sulphur. An additional precaution was to cover the top of the can with lime. This was used as an absorbent for sulphur, and no doubt helped to take it up and hold it. The lime, however, was rather an irritant to the men when packing and emptying cans.

My own experience is greater with coke packings than with cast iron borings, but from what I have seen of both kinds the white, hard, unmachinable skin is thicker with coke packing than it is with cast iron borings.

Conclusion

Non-continuous annealing ovens produce softer castings than continuous ovens.

The hard skin which occasionally appears on the castings is due to the influence of excessive sulphur contained in the packing material. Also, the sulphur originally present in the packing material is augmented during each subsequent heating, and this additional sulphur comes from the fuel used in firing.

Coke dust contains from five to ten times the quantity of sulphur contained in cast iron borings and thus gets more quickly to the point at which it parts with sulphur to the castings.

If coke dust is used, an addition of lime retards the effect of the sulphur.

Coke dust sags during annealing more than cast iron boring, and with it warped castings are more common, especially if there has been overheating of the oven.

The packings should be changed often so that the sulphur may not reach the saturation point where it passes the sulphur into the castings.

Permanent Mold Compound

A new molding compound recently has been patented, which consists of powdered soapstone, 11 parts, and Portland cement, 1 part. These two ingredients are mixed and then wet with a solution of 2 parts of water and 1 part of water glass. The mixture is wet to the consistency of tempered molding sand and is employed in the same manner as the latter. Also, the mixture may be poured over the pattern when of the consistency of thick molasses and after allowing it to set for 48 hours it hardens to the consistency of wax. After the pattern has been removed, the mold is heated to a temperature of from 300 to 500 degrees Fahr., is thoroughly dried and then is ready for use.

PERIMETER OR GIRTH TABLE FOR DETERMINING THE WEIGHT OF IRON CASTINGS.

By R. R. McGowan.

EXAMPLES SHOWING HOW TO USE THE TABLE.

No. 1.—Find the weight of an irregularly shaped casting as shown in Fig. 1. Its perimeter or girth measured with a piece of cord along *A*, *B*, *C*, the center of its section is *27* inches; the thickness of the casting is ½ inch; the total length of casting is 6 feet *2* inches.

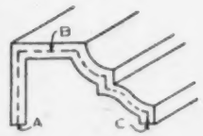


FIG. 1

From table:—

Pounds.

27-in. girth x ½-in. thick per ft. l'gth = 42.12

Therefore

27-in. girth x ½-in. thick per 6 ft. = 42.12 × 6 = 252.72

and

27-in. girth x ½-in. thick per *2* in. = 42.12 ÷ 6 = 7.02

Weight of casting = 252.72 lbs. + 7.02 lbs. = 259.74 lbs.

No. 2.—Find the weight of a cast iron plate as shown in Fig. 2.

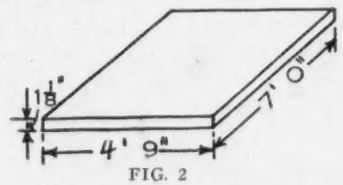


FIG. 2

From table:—

29-in. girth x 9/16-in. thick = 50.90 lbs. per ft.
28-in. girth x 9/16-in. thick = 49.14 lbs. per ft.
57-in. girth x 9/16-in. thick = 100.04 lbs. per ft.

Therefore

57-in. girth x 1⅛-in. thick = 100.04 lbs. × *2* = 200.08 lbs. per ft.
Weight of casting = 200.08 lbs. × *7* = 1,400.56 lbs.

Example No. *2* is given to show how table may be extended to meet practically any circumstances.

DATA SHEET No. 165, THE FOUNDRY, JULY, 1914.

Note—This sheet may be cut into two sections, 8 x 7 inches, and may be readily bound in note-book form.

TABLE FOR FINDING WEIGHTS OF CASTINGS

Girth, in.	Thickness of Metal in Inches. Weight in Pounds per 1 Foot in Length. ⅛	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	Girth, in.
¼	0.098	0.122	0.146	0.171	0.195	0.219	0.244	0.268	0.293	0.317	0.341	0.366	0.390	0.415	0.439	¼
½	0.195	0.244	0.293	0.341	0.390	0.439	0.488	0.536	0.585	0.634	0.683	0.731	0.780	0.829	0.878	½
1	0.39	0.49	0.585	0.683	0.78	0.878	0.975	1.07	1.17	1.27	1.37	1.46	1.56	1.658	1.76	1
2	0.78	0.98	1.17	1.37	1.56	1.76	1.95	2.15	2.34	2.54	2.73	2.93	3.12	3.315	3.51	2
3	1.17	1.46	1.76	2.05	2.34	2.63	2.93	3.22	3.51	3.80	4.10	4.39	4.68	4.97	5.27	3
4	1.56	1.95	2.34	2.73	3.12	3.51	3.90	4.29	4.68	5.07	5.46	5.85	6.24	6.63	7.02	4
5	1.95	2.44	2.93	3.41	3.90	4.39	4.88	5.36	5.85	6.34	6.83	7.31	7.80	8.29	8.78	5
6	2.34	2.93	3.51	4.10	4.68	5.27	5.85	6.44	7.02	7.61	8.19	8.78	9.36	9.95	10.53	6
7	2.73	3.41	4.10	4.78	5.46	6.14	6.83	7.51	8.19	8.87	9.56	10.24	10.92	11.60	12.29	7
8	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.58	9.36	10.14	10.92	11.70	12.48	13.26	14.04	8
9	3.51	4.39	5.27	6.14	7.02	7.90	8.78	9.65	10.53	11.41	12.29	13.16	14.04	14.92	15.80	9
10	3.90	4.88	5.85	6.83	7.80	8.78	9.75	10.73	11.70	12.68	13.65	14.63	15.60	16.58	17.55	10
11	4.29	5.36	6.44	7.51	8.58	9.65	10.73	11.80	12.87	13.94	15.02	16.09	17.16	18.23	19.31	11
12	4.68	5.85	7.02	8.19	9.36	10.53	11.70	12.87	14.04	15.21	16.38	17.55	18.72	19.89	21.06	12
13	5.07	6.34	7.61	8.87	10.14	11.41	12.68	13.94	15.21	16.48	17.75	19.01	20.28	21.55	22.82	13
14	5.46	6.82	8.19	9.56	10.92	12.29	13.65	15.02	16.38	17.75	19.11	20.48	21.84	23.21	24.57	14
15	5.85	7.31	8.78	10.24	11.70	13.16	14.63	16.09	17.55	19.01	20.48	21.94	23.40	24.86	26.32	15
16	6.24	7.80	9.36	10.92	12.48	14.04	15.60	17.16	18.72	20.28	21.84	23.40	24.96	26.52	28.08	16
17	6.63	8.29	9.95	11.60	13.26	14.92	16.58	18.23	19.89	21.55	23.21	24.86	26.52	28.18	29.84	17
18	7.02	8.78	10.53	12.29	14.04	15.80	17.55	19.31	21.06	22.82	24.57	26.33	28.08	29.84	31.59	18
19	7.41	9.26	11.12	12.97	14.82	16.67	18.53	20.38	22.23	24.08	25.93	27.79	29.64	31.49	33.35	19
20	7.80	9.75	11.70	13.65	15.60	17.55	19.50	21.45	23.40	25.35	27.30	29.25	31.20	33.15	35.10	20
21	8.19	10.24	12.29	14.33	16.38	18.43	20.48	22.52	24.57	26.62	28.67	30.71	32.76	34.81	36.86	21
22	8.58	10.73	12.87	15.02	17.16	19.31	21.45	23.60	25.74	27.89	30.03	32.18	34.32	36.47	38.61	22
23	8.97	11.21	13.46	15.70	17.94	20.18	22.43	24.67	26.91	29.15	31.40	33.64	35.88	38.12	40.37	23
24	9.36	11.70	14.04	16.38	18.72	21.06	23.40	25.74	28.08	30.42	32.76	35.10	37.44	39.78	42.12	24
25	9.75	12.19	14.63	17.06	19.50	21.94	24.38	26.81	29.29	31.69	34.13	36.56	39.00	41.44	43.88	25
26	10.14	12.68	15.21	17.75	20.28	22.82	25.35	27.89	30.42	32.96	35.49	38.03	40.56	43.10	45.63	26
27	10.53	13.16	15.80	18.43	21.06	23.69	26.33	28.97	31.59	34.22	36.86	39.49	42.12	44.75	47.39	27
28	10.92	13.65	16.38	19.11	21.84	24.57	27.30	30.03	32.76	35.49	38.22	40.95	43.68	46.41	49.14	28
29	11.31	14.14	16.97	19.79	22.62	25.45	28.28	31.10	33.93	36.76	39.59	42.41	45.24	48.07	50.90	29
30	11.70	14.63	17.55	20.48	23.40	26.33	29.25	32.18	35.10	38.03	40.95	43.88	46.80	49.73	52.65	30
31	12.09	15.11	18.14	21.16	24.18	27.20	30.23	33.25	36.27	39.29	42.33	45.34	48.36	51.38	54.41	31
32	12.48	15.60	18.72	21.84	24.96	28.08	31.20	34.32	37.44	40.56	43.68	46.80	49.92	53.04	56.16	32
64	24.96	31.20	37.44	43.68	49.92	56.16	62.40	68.64	74.88	81.12	87.36	93.60	99.84	106.08	112.32	64

If the above weights, which are for cast iron, be multiplied by	
1.08	it will give the weight of a similar casting in wrought iron or steel
1.154	it will give the weight of a similar casting in brass
1.54	it will give the weight of a similar casting in lead
0.36	it will give the weight of a similar casting in aluminum

Girth, in.	⅛	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	Girth, in.
¼	0.463	0.488	¼													
½	0.926	0.975	½													
1	1.85	1.95	1													
2	3.71	3.90	2													
3	5.56	5.85	3													
4	7.41	7.80	4													
5	9.26	9.75	5													
6	11.12	11.70	6													
7	12.97	13.65	7													
8	14.82	15.60	8													
9	16.67	17.55	9													
10	18.53	19.50	10													
11	20.38	21.45	11													
12	22.23	23.40	12													
13	24.08	25.35	13													
14	25.93	27.30	14													
15	27.79	29.25	15													
16	29.64	31.20	16													
17	31.49	33.15	17													
18	33.35	35.10	18													
19	35.20	37.05	19													
20	37.05	39.00	20													
21	38.90	40.95	21													
22	40.76	42.90	22													
23	42.61	44.85	23													
24	44.46	46.80	24													
25	46.31	48.75	25													
26	48.17	50.70	26													
27	50.02	52.65	27													
28	51.87	54.60	28													
29	53.72	56.55	29													
30	55.58	58.50	30													
31	57.43	60.45	31													
32	59.28	62.40	32													
64	118.46	124.80	64													

(For method of interpolation, see Data Sheet No. 129.)

DATA SHEET No. 166, THE FOUNDRY, JULY, 1914.

THE FOUNDRY DATA SHEET, JULY, 1914

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

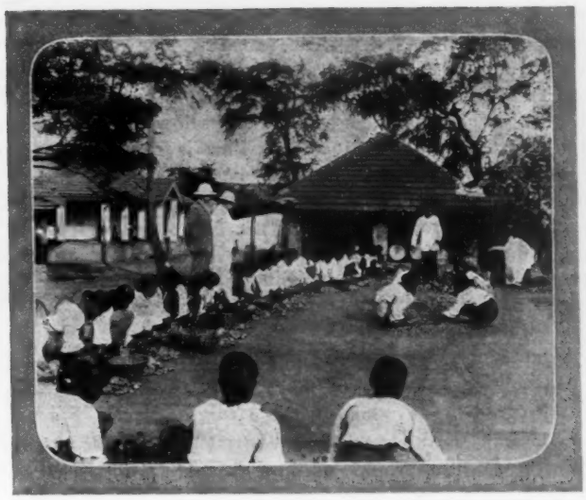


FIG. 1—COBBING AND SORTING UNCURED PLUMBAGO

FIG. 2—SIEVING AND SORTING LUMP AND CHIP PLUMBAGO

Sorting and Curing Plumbago in Far-off Ceylon

MINING, sorting and handling plumbago in Ceylon is an exceedingly interesting operation, owing to the primitive methods employed, and in the accompanying illustrations the natives are shown at work in two of the plumbago compounds operated by Pettinos Brothers, New York City. The photographs were made at Colombo last winter by Dwight L. Elmendorf, the well known lecturer, who at present is giving interesting talks on Ceylon in various parts of this country, and he illustrates with moving pictures the operations of mining, sorting and handling plumbago.

The native women are skilled workers and they rapidly pick and sort the mineral into its various sizes and grades. While the entire operation is primitive and is devoid of the aid of machinery, nevertheless it is surprisingly effective and the cheap native labor renders it exceedingly economical. The plumbago is sorted into four sizes, namely, lump, chip, dust and flying dust. In addition, there are various grades of each size. The lump and chip are used almost entirely by the manufacturers of crucibles, while the dust and flying dust grades are purchased by the grinding trade, such as manufacturers of foundry facings, stove polish, paints, greases, etc. The lump and chip grades command the highest prices and, therefore, every effort is made to produce as little dust and flying dust as possible.

FIG. 3—UNCURED STOCK BEFORE TREATMENT

During the last year Ceylon has been visited by abnormal and continuous rains, greatly damaging the mines, roads, bridges, etc., and as a result, the production of plumbago has been greatly reduced. Coolie labor also has become somewhat scarce, partly owing to the new and ex-

FIG. 4—INTERIOR OF A PLUMBAGO COMPOUND

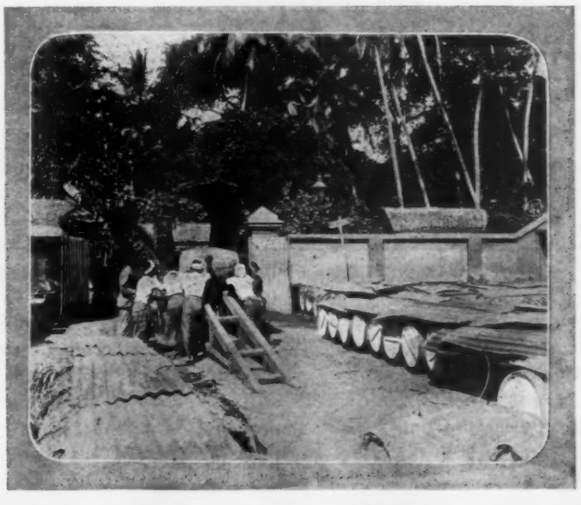


FIG. 5—LOADING BARRELS OF CURED PLUMBAGO FOR DELIVERY TO THE VESSEL

tensive rubber developments in Ceylon and labor has been advanced. Furthermore, mines are getting deeper and the cost of their operation has increased. These factors have resulted in maintaining the price of plumbago notwithstanding the falling off in demand in various parts of the world.

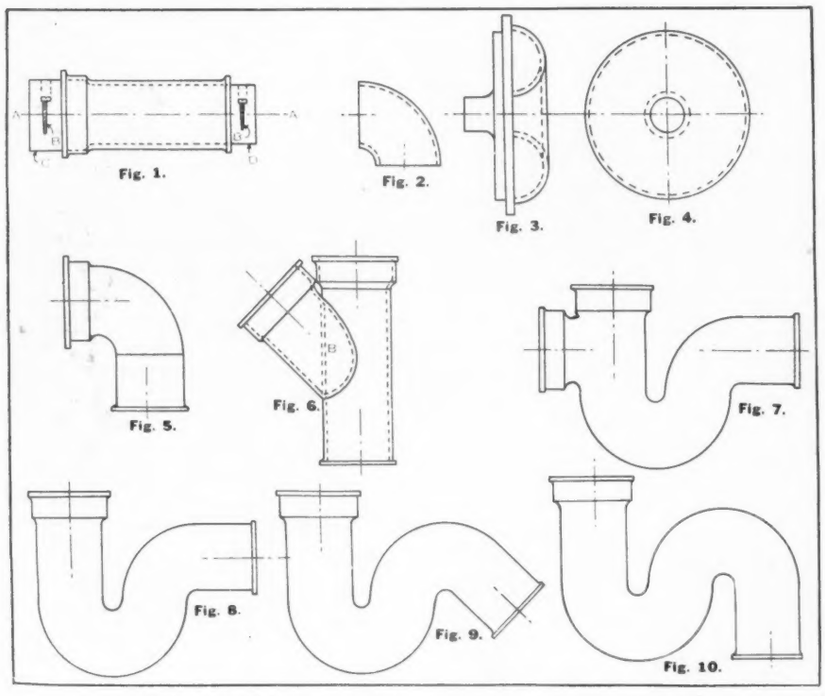
In the accompanying illustrations the natives are shown cobbing and sorting uncured lump plumbago in Fig. 1 and in Fig. 2 they are sieving and sorting lump and chip grades. Fig. 3 shows the uncured stock before treatment, while the interior of a plumbago compound is shown in Fig. 4 and the primitive method of loading barrels of plumbago is illustrated in Fig. 5.

Fitting Patterns

By H. J. Murphy

In an article on plaster patterns published in a recent issue of THE FOUNDRY, the author described an ancient method of making a quarter bend pattern and he pointed out the advantages of making this in plaster of paris or stucco. However, I do not agree with his statements in reference to the production of patterns for the smaller sizes of soil fittings, approximately from 2 to 6 inches in diameter with a thickness of only ⅛ or ¼ inch. For several years the writer has made patterns for soil pipe fittings by both the lead and plaster methods. The method of making the plaster fitting patterns differs somewhat from that described in the January, 1914, issue of THE FOUNDRY, but this method will not be considered at this time and this article will be devoted to the so-called lead method. However, pure lead is not used, as the alloy is a composition of lead and antimony, having approximately the same proportions of each, the same as in type metal mixtures.

In the accompanying illustrations, Fig. 1 shows a block from which the original lead pattern is made. This block is divided into halves and is jointed on the line *H*, being held together with two screws. These blocks are approximately 18 inches long. After being turned to the outside size of the hub and spigot of the fitting, and after the straight section of the pattern between the hub and spigot is turned to the size of the body, including the formation of the prints *C D*, the block is removed from the lathe, the screws are taken out and one-half of the block is taken to the foundry. After a mold is made from the block, it is returned to the shop and a thickness is machined off, as shown by the dotted line, Fig. 1. This block then becomes the core and is again taken into the foundry, the core is made and the mold is poured. If fine brass sand has been used, and if care has been exercised in molding and gating, very little finishing will be required excepting cutting off the gates. This casting then forms the master pattern from which other patterns are made. The same method is pursued for making the sweep part of the bend, Fig. 3, and when cast, one-half of a hollow cylindrical ring is formed. This is cut into quarters, one quarter being used for the original sweep pattern. These master patterns with one more sweep of a small radius will serve for an entire line of 4-inch fittings of which there may be 100 different styles.



MAKING LEAD PATTERNS FOR SOIL PIPE FITTINGS

Making Quarter Bend Pattern

To make a quarter bend pattern, one of the straight pieces, Fig. 1, is taken and after removing the hub and spigot ends, the sweep is soldered into position, as shown in Fig. 5. This is then turned over. The other half is built on top and after smoothing the soldered joint, the pattern is ready for the foundry. From this pattern an iron shell pattern is made. In the soil pipe fitting trade 1/5, 1/6, 1/8 and 1/16 bends are required. After the quarter bend pattern has been cast, the lead pattern is cut, first to 1/5, then to 1/6, 1/8 and 1/16 bends.

The making of a Y pattern next will be considered. One of the straight pieces is cut and soldered together to the required length of the body of the fitting and two other hub ends are fitted and soldered in place, the one being attached at an angle of 45 degrees, as shown in Fig. 6, and the wall of the body is cut out where the branches intersect, as shown at *B*. This Y is made in different lengths, and after the iron pattern has been cast, the lead patterns can be used for making iron patterns of different lengths by soldering pieces onto the spigot end.

In making trap patterns, four of the smaller radius bends are soldered together, the hub, spigot and vents are attached by soldering and the pattern is turned over and the other half is built on top of this. Different styles of trap patterns are shown in Figs. 7, 8, 9 and 10. If the pattern, Fig. 7, is made first, it can be cut and the parts can be used for the other patterns. The greatest advantage to be derived from this system is noted when an entire line of fitting patterns is to be made. This is not a new method of making fitting patterns, but for the class of work for which it is adapted it is both rapid and economical.

The P. F. Murk Foundry Co., South Beloit, Wis., is having plans made for the erection of a 60 x 80 foot addition next fall.

A Device for Preventing Cupola Explosions*

Safety Measures Adopted Abroad to Reduce Accidents in Foundries Arising From Furnace Operations

By Franz Osswald†

THE operation of cupolas as well as blast furnaces is attended with danger of explosions, which under certain conditions may result in disaster. Such explosions, practically without exception, are due to the presence of carbon monoxide in the wind box and sometimes even in the blast pipe. These conditions are made possible by short interruptions in operation during which the blast is shut off and the gas backs up through the tuyeres. The gas is ignited by the hot coke in the cupola as soon as the wind is turned on again and a more or less violent explosion follows.

A very instructive paper on the causes and effects of a cupola explosion in which four men were hurt more or less seriously was presented at a recent meeting of the German Association of Foundrymen. Another cupola explosion in which two persons were hurt was reported by the Prussian board of industrial inspection in 1910. In both these cases the explosions were particularly severe, whereas those of minor consequence are seldom made public; the cupola attendants often do not even report them to the men in charge.

Some Well-known Safety Devices

Among the safety devices generally in use to mitigate the effects of these accidents may be included the explosion doors which are sometimes attached to the blast pipe or wind box and the stop valve which prevents the carbonic oxide gas from entering the blast pipe. The latter must be closed by hand in case of short interruption in operation, and should be located next to the wind box, as close as possible to the cupola. The valve, of course, cuts off only the blast pipe and does not prevent the dangerous gas from entering the wind box.

Certain German industrial authorities specify that doors shall be placed in front of the tuyeres which can be opened as soon as the blast is shut off; the outside air thus admitted will burn the gas escaping through the tuyeres. When the blast is again turned on, the doors must remain open to allow passage for any gas remaining in the air jacket. They should not be closed until the blast has entered the cupola. In actual operation, however, these precautions are frequently neglected. Their execution is usually left to the cupola tender, and when the blower unexpectedly shuts down, it often happens that instead of remaining to carry out the instructions, he will first leave for the engine room to learn the cause of the disturbance and its probable duration. This short delay in conforming to instructions might give rise to a violent explosion when the blower is started again. In case of turbo-blowers, which are almost soundless in operation, another difficulty is added. The air valve in the engine room may be temporarily shut without the cupola tender even knowing the blast is off, and when the valve is again opened, will he be aware of what has happened from the detonations in the cupola? The admonition to leave the tuyere doors open when the blast is turned on after a temporary shut-down, is not readily lived up to by the melter who finds it a troublesome job to close the doors against the escaping air.

For these reasons it has proved desirable to find means for taking the necessary precautions independently of the cupola attendants, by aid of a simple automatic valve arrangement. An apparatus designed for this purpose is shown in Figs. 1 and 2. Its lower portion is arranged as a suction or intake valve, while the upper part of the apparatus contains a safety or blow-off valve. The valve casing is fastened to the wind box by studs, as far below the lowest tuyere as possible. A wire sieve is inserted between the wind box and the valve casing to prevent the passage of foreign material. The suction valve is ordinarily held open by a helical spring provided with screw adjustment. The valve body is thus kept floating free of the seat and air has access to the interior of the cupola through numerous holes in the valve cover. The spring is so adjusted that the valve body will be pressed against the seat for a blast pressure equivalent to about 8 inches water column. When the wind is shut off, the valve will open when the pressure has decreased to this point.

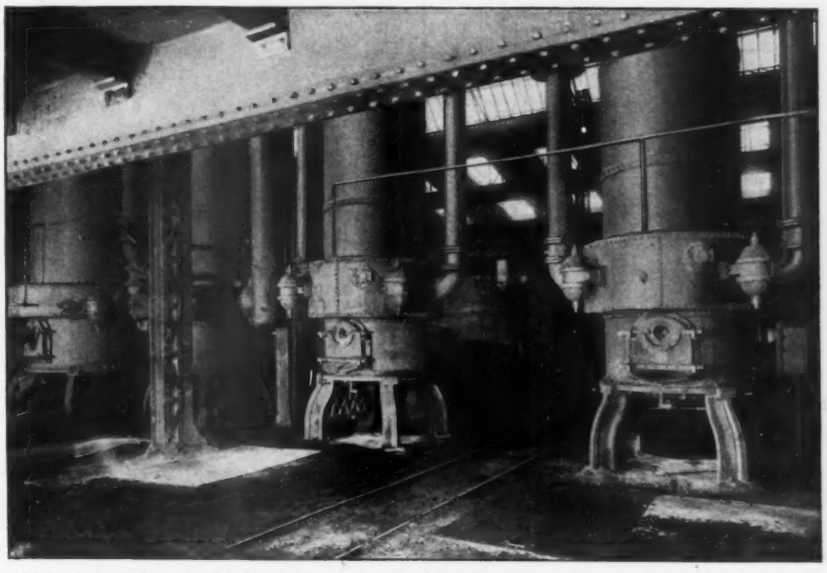


FIG. 1—FOUR CUPOLAS IN A LARGE GERMAN FOUNDRY EQUIPPED WITH DEVICES TO PREVENT EXPLOSIONS

The safety valve in the upper part of the apparatus is similar to the suction valve except that the safety valve body is normally pressed against the valve seat by a spring, which is set

*Translated from Stahl und Eisen specially for The Foundry, by Gustav Fisk.

†Industrial Inspector for the Imperial government, Vienna.

for the highest working pressure of the cupola. The valve will open when the maximum working pressure is exceeded.

The valve casing should be so located on the wind box as to cause a strong draft through the suction valve in connection with the cupola stack. The zone of fusion in cupolas provided with this safety apparatus is supplied with air as long as the blast is off. After the blast is turned on a certain time will elapse before the pressure is reached at which the suction valve will close and in the meantime the position of the valve disc will permit the blast and any gas present in the wind box to escape into the open air. When the required pressure is reached the suction valve will close. When the blast is shut

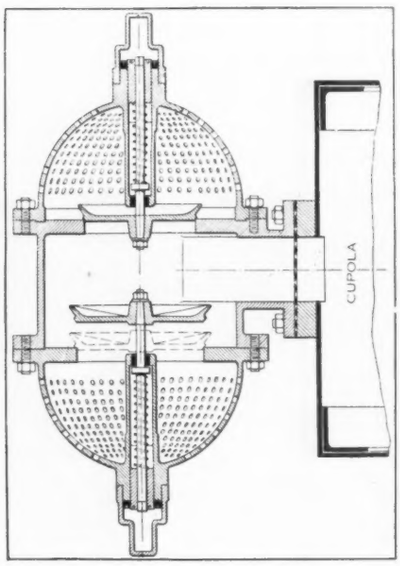


FIG. 2 — VERTICAL SECTION OF CUPOLA SAFETY DEVICE

off, the drop in pressure will cause the suction valve to open automatically at the pressure for which the valve spring is set, and air is again admitted to the zone of fusion in the cupola. In this way the formation of carbon monoxide is prevented and explosions are avoided.

The safety valve in the top part of the casing serves for additional security in emergencies. In case of slagging the tuyeres, a portion of the wind will be released automatically by the valve; where a Roots blower is furnishing the blast, both it and the motor will be protected from undue loads.

The safety apparatus is best located on the cupola opposite the tapping hole, and for the sake of further security, two appliances should be provided for each cupola. Fig. 3 shows the apparatus attached to the wind box. The valve areas are proportioned to the inside diameter of the cupola and the capacity of the blower.

The apparatus was designed by the Aktien-Gesellschaft, R. Ph. Waagner; L. & Q. Biro and A. Kurz, of Vienna.

The Cupola Bridging Problem

By T. Ben Bennett

In the April issue of THE FOUNDRY, page 162, the cupola bridging problem was discussed. In our shop we experienced this difficulty for a period of six months, although for many years we never had a hang-up in our furnace. The laborer who supervised the charging of the cupola, unfortunately, however, became crippled and he was transferred to another department. However, he instructed a new melter, and for a period of two months we experienced absolutely no trouble. I then went on a vacation for a week and upon my return I found that we had hardly had a satisfactory heat during my absence. Everything was checked over and the weights and measures were found to be correct. I began changing the charges, blast pressure, fluxes, etc. Several good foundrymen gave me valuable pointers on almost every subject except the one I was confronted with.

Finally, the former melter was returned to the charging floor for a day and the heat was satisfactory. Therefore, I came to the conclusion that the trouble was with the man and not with the blast, coke or iron. As soon as the new melter was on the job again, however, the same trouble recurred and finally the melter quit his job in disgust. I personally instructed the new melter and have not had a hang-up since the second melter left. The entire trouble was traced to the charging, and I am certain that the difficulties referred to in the April issue of THE FOUNDRY can likewise be traced to some irregularity in charging the iron and coke. We found that the iron was not placed sufficiently close to the sides of the cupola, permitting the blast free passage between the sides of the cupola and the iron. The melted particles of iron coming in contact with this strong blast froze to the sides of the cupola, a small amount at a time, until the opening in the center of the furnace where the melting actually was being done became so contracted that the stock could not move down to the melting point.

If you are experiencing bridging difficulties, examine the cupola the morning after a hang-up and see if the furnace lining does not bear out my contention. Keep your coke level, charge a layer of pig iron, followed by a layer of scrap, etc, but be careful that all of the stock is kept close to the sides of the cupola. You will be surprised to find that you can melt without the use of a flux and in almost any proportion within reason, and you will get a good, clean drop. However, it should be pointed out that there is one right proportion for each individual cupola, which can be readily ascertained, and when these conditions are met, then, and only then, will your cupola give you the best possible results.

Another View on Cupola Bridging

By Edgar Allen Custer

In the April issue of THE FOUNDRY, page 162, W. J. Keep discussed the cupola bridging problem, but I am inclined to take issue with him on

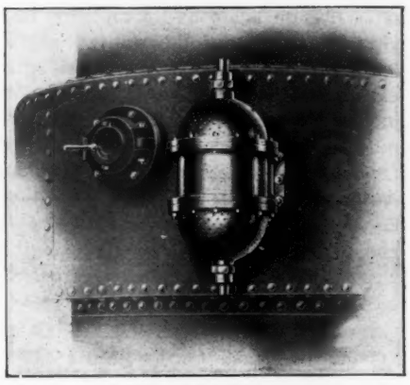


FIG. 3—SAFETY APPARATUS FIXED TO WIND BOX

this subject. It has been my experience that the bridging of cupolas has been due to high blast velocity. With a cupola charged and operated as given in the question, no trouble should be experienced from bridging provided the velocity of the blast is cut down after melting has commenced. To accomplish this without cutting down the air supply, the tuyeres may be opened sufficiently to give an area largely in excess of the requirements with the blast pressure at one-half the normal, which in this case is 12 ounces. When this is done, the charging should be continued in the manner prescribed by Mr. Keep with the exception that I would begin using the flux on the first charge following the bed. The blast should be started with the full pressure of 12 ounces and should be continued at that pressure until there is a fair supply of molten iron on the bed. The blast then should be reduced to six or seven ounces and should be continued at that rate.

THE BRASS FOUNDRY

Non-Ferrous Test Specimens Compared

AT THE annual meeting of the American Society for Testing Materials, held at Atlantic City, June 30 to July 3, L. P. Webbert presented an interesting paper giving the results of a study of the strength of non-ferrous castings, from a comparison of different test specimens.

The object of the investigations was to note the changes in strength that occur in different thicknesses of metal castings made from the non-ferrous metals met with in engineering practice. The knowledge desired, from the machine-designer's point of view, is to know how to proportion the separate parts of a design with regard to strength, and to know what physical properteis to expect from a casting at different points, or as a whole.

Description of Test Specimens

Some metallurgists strive to adopt a test specimen to represent the strength of an alloy which will give the maximum results obtainable for that metal. Such test specimens give results that are interesting, but tend to mislead. Quite a number of different types have been suggested for adoption as a standard test specimen, but when we consider the specifications that must be

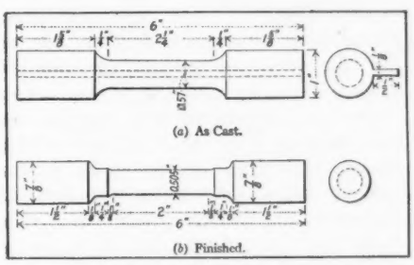


FIG. 1—TEST SPECIMEN FOR 88-10-2 CASTING

followed in practice our choice becomes decidedly restricted to a few forms. The specifications state that a test specimen is to be a part of the casting and is not to be cast separately. The test specimen must receive the same heat treatment—that is, no chilling of the test specimen is allowable—and must be turned down to a stated diameter.

There are two styles of test specimens made use of in practice, one for the copper-tin alloys and the other for the copper-zinc alloys. The first is that used on 88-10-2 castings (copper

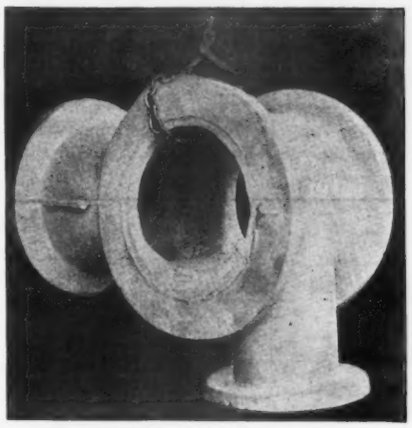


FIG. 2—CASTING 88-10-2, SHOWING TEST SPECIMEN ATTACHED

88 per cent, tin 10 per cent, zinc 2 per cent). This test specimen, as cast with the casting, has the dimensions shown in Fig 1, *a*. A ⅛ inch gate running the entire length of the test specimen connects it with the casting. A casting with the test specimen attached is shown in Fig. 2. Being gated in this manner allows the test specimen to be filled quickly with metal and has the advantage of giving the same rate of cooling to every part of the specimen. When the test specimen is detached it is turned down in a lathe to the proper diameter and form as shown in Fig. 1, *b*. In Fig. 4, *c*, are shown the forms placed in the parting of the mold; two forms to give test specimens 0.505 inch in diameter, and one to give a test specimen 0.798 inch in diameter. When a test specimen is to be placed at another part of the casting, cores are made use of as shown in Fig. 5, *b* and *c*. At *b* are shown cores to give 0.798 inch test specimens and at *c* are shown those to give 0.505 inch test specimens.

The test specimen shown in Fig. 1, with a finished diameter of 0.505 inch, is used more than the test specimen having a finished diameter of 0.798 inch. A drawing of the 0.798 inch specimen would be similar to Fig 1, but would show larger diameters and greater thickness of gate.

For the copper-zinc alloys (manganese-bronze and brass) a bar of metal 1 x 1¼ x 6 inches is cast on the side of the casting. Fig. 4, *b*, shows two patterns for this style of test specimen, the diameter of which is to be 0.505 inch. These patterns are placed against flat surfaces. For curved surfaces different patterns are made to fit the curvature of the castings. The round part of the pattern shown in Fig. 4, *b*, allows the pattern to be drawn easily from the sand.

Preserving the Skin

It is well known that to obtain the highest results from 88-10-2 test specimens the least amount of metal should be turned off the specimen. In comparing Fig. 1, *a* with *b* it will be noted that 0.065 inch of metal is turned from the test specimen. In the skin of the casting lies the greatest strength, as the foundryman puts it. To illustrate, a large valve body, ¾ inch in thickness, made from 88-10-2 metal, was cut

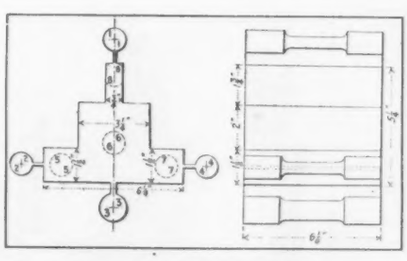


FIG. 3 — TEST BLOCK, SHOWING DIMENSIONS AND NUMBERING OF TEST SPECIMENS

up to procure test specimens from the flange and body of the casting, in order to compare the strength of these with the strength of the test specimen attached to the casting. The test specimen (0.505 inch in diameter) gave an ultimate tensile strength of 40,000

pounds per square inch and an elongation in 2 inches of 40 per cent. From skin, so to speak, to the specimen and consequently more strength obtainable

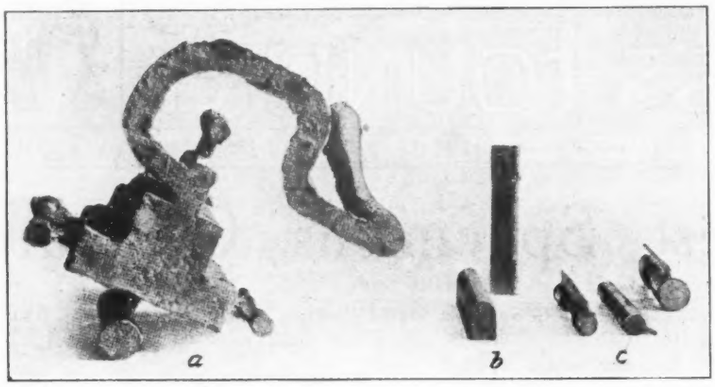


FIG. 4—(a) MANGANESE BRONZE TEST BLOCK; (b) MANGANESE BRONZE TEST SPECIMENS; (c) TEST SPECIMEN FOR COPPER-TIN ALLOYS

the body the following results were obtained:

	—1—	—2—
Tensile strength, pounds per square inch.....	25,800	25,200
Elongation in 2 inch, per cent	13.0	11.0

From the flange the following results were obtained:

	—1—	—2—
Tensile strength, pounds per square inch.....	23,650	18,850
Elongation in 2 inch, per cent	11.0	5.0

When the test specimen was turned down to the proper diameter, very little of the skin was turned off. The test pieces from the interior of the metal possessed no skin and gave lower results. The results emphasize the fact that the test specimen attached to the casting exaggerates the strength of the casting as a whole.

If the diameter of this style of test specimen is increased lower results are obtained. Let us compare the 0.505 inch diameter test specimen (0.2 square inch in area) with the 0.798 inch diameter specimen (0.5 square inch in area). The ratio of the area of the 0.505 inch test specimen to the circumference is smaller (area ÷ circumference = 1.26) than the ratio of the area of the 0.798 inch test specimen to its circumference (area ÷ circumference = 1.99). In the former case we state that there is more than with the larger-diameter specimen. The author has averaged 61 tests from large castings having the 0.505 inch test specimen and gives the following average: Tensile strength, 46,580 pounds per square inch; elongation in 2 inches, 38.7 per cent. Among these tests a maximum tensile strength of 51,650 pounds per square inch is noted, with an elongation of 62.5 per cent, which is also the maximum elongation. The minimum tensile strength among the tests is 39,100 pounds per square inch with an elongation of 25 per cent. The minimum elongation is 20 per cent. The specifications under which these castings were made required a minimum tensile strength of 30,000 pounds per square inch and a minimum elongation of 20 per cent in 2 inches. A specification from another source called for a minimum tensile strength of 35,000 pounds per square inch and a minimum elongation of 20 per cent in 2 inches for a test specimen of 0.5 square inch area (0.798 inch in diameter). This style of test specimen was placed on ten large 88-10-2 worm wheels. The tests gave an average tensile strength of 36,324 pounds per square inch, and an average elongation of 27.1 per cent. The maximum tensile strength among the tests was 42,800 pounds per square inch, with an elongation of 36 per cent, which was also the maximum elongation. The minimum tensile strength was 29,300 pounds per square inch, with an elongation of 17 per cent, which was the minimum elongation. Among these ten wheels there were two—one with a test specimen that pulled 32,500 pounds per square inch with an elongation of 21 per cent, and another with a tensile strength of 29,300 pounds per square inch, and an elongation of 17 per cent—that did not pass specifications. No doubt exists that had the 0.505 inch diameter test specimen been used all tests would have given higher results.

Table I
ANALYSIS OF ALLOYS

Alloy No.	Percentage of Copper.	Tin.	Zinc.	Lead.	Iron.	Mang.	Alum.	Phos.
1	88.31	8.49	3.20	....	....	....	....	trace
2	87.98	10.64	1.28	0.10	....	....	....	trace
3	86.78	6.31	5.96	0.92	0.03	....	....	trace
4	84.28	11.31	4.15	0.06	0.06	....	....	trace
5	62.81	0.79	26.18	0.09	0.05	0.02	0.06	.....
6*	62.81	0.79	26.18	0.09	0.05	0.02	0.06	.....
7	84.49	.....	15.49	....	0.02	....	....	.....
8†	.....	.....	.....	....	....	....	....	.....
9	57.66	0.84	39.85	....	0.69	0.16	0.58	.....
10	89.08	7.48	3.00	0.07	....	....	....	0.20

*Alloy No. 5 remelted.
†Analysis not made. Manganese bronze.

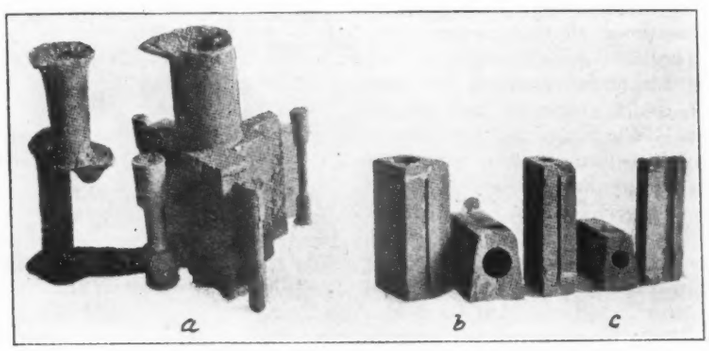


FIG. 5—(a) TEST BLOCK, 88-10-2; (b) AND (c), CORES USED FOR SPECIMENS NOS. 1, 2, 3 AND 4, FIG. 3

We can conclude, therefore, that for this style of specimen used on copper-tin alloys, the smaller ratio of area to circumference of test specimen gives the greater strength. This is due to the fact that in general the rate of freezing of the metal is an important factor in influencing the strength of the casting. The skin of the casting receives the chill of the mold, is the first to freeze, and shows the smallest structure or grain. From the skin, freezing of the metal takes place gradually toward the center of the casting. The rate of freezing depends upon the following factors: (1) The thickness of the casting; (2) the temperature of the metal entering the mold; and (3) the conductivity of the mold.

To study the effect of the rate of freezing upon the strength of the metal, castings of copper-tin and copper-zinc alloys were made as shown in Fig. 3, Fig. 4 *a* and Fig. 5 *a*. Fig. 5 *a* shows a block made of 88-10-2 metal

with the test specimens attached which are used for this metal. Fig. 3 shows the arrangement of specimens and numbering on blocks made of copper-tin and copper-zinc alloys. Test specimens Nos. *1*, *2* and *4* are of the pattern shown in Fig. 1. No. *3* is a similar test specimen to be turned down to a diameter of 0.798 inch. Nos. *5*, *7* and *8* are test specimens used on castings made of copper-zinc alloys (manganese-bronze and brass). A bar of metal is cut out of the center of the casting and turned down into a test specimen to represent the strength of the metal at the center. The relative advantages of these types of test specimens can be studied, since they are cast together on the same casting, are made from the same metal, and receive the same heat treatment. The specimens on all blocks made were numbered as shown in Fig. 3. Tables I and II give the results of all tests. The test specimens were not threaded but were pulled with grip jaws in the testing machine. In turning down the test specimens, Nos. *5*, *6* and *7* were given a diameter of 0.798 inch. The diameter was later changed to 0.505 inch in order to obtain uniformity in the size of the test specimens. Test specimen No. 3 was given a diameter of 0.798 inch for all blocks. In some instances this specimen was turned down to a smaller diameter when found slightly defective.

A few changes had to be made when casting the manganese-bronze blocks, on account of the nature of the metal. The risers were made larger, the sprues longer and the gates connecting test specimens Nos. *1*, *2*, *3* and *4* were made thicker. On the brass blocks the sprues were made similar to those of the manganese-bronze blocks; otherwise they were similar to those of the copper-tin alloys. After casting, the metal was churned in the riser in every case. Specimens Nos. *1*, *2* and *4* were attached with the intention of observing how closely they would check each other when tested, thereby testing the reliability of this type of test specimen when made of the different metals. It may be mentioned that this type can not be depended upon when attached to brass castings.

Use of Green Sand Mold

With some alloys a green sand mold was made. This mold was filled immediately after the dry sand mold was filled. The metal for both molds was poured from the same crucible. The castings made in green sand gave results that showed no decided variation from those made in the dry sand. The green sand molds were soon discontinued. Only the average results from the green sand blocks are given in Table II.

The block for alloy No. 1 was cast after the casting shown in Fig. 2 was poured. This metal was made from the best copper, tin and zinc obtainable, but was not remelted. The temperature was not taken when the block was cast but was lower than the pouring temperature usually desired for such a small casting. The specimen attached to the casting in Fig. 2 was pulled and gave a tensile strength of 49,150 pounds per square inch and an elongation of 47.5 per cent.

For alloy No. *2* a different procedure was adopted. In order to get a perfect and homogeneous alloy the metals for this block were alloyed and the resulting alloy pigged. The metal was remelted, brought to the proper temperature in the furnace and cast. The casting after being cut up was found to be perfect.

Alloy No. *8*, manganese bronze, gave trouble. At the center of the block near the top sponginess occurred, due to shrinkage. In practice this trouble is overcome by pouring metal at a higher temperature from another crucible into the riser during churning to liven up the metal in the center. Only

Table II

RESULTS OF TESTS

Alloy No. 1.—Copper-Tin; New Metal; Not Remelted.

Test Specimen No.	Diameter of Test Specimen, in.	Tensile Strength, pounds per sq. in.	Elongation in 2 inch., per cent.
1	0.505	40,800	28.0
2	0.505	43,250	32.0
3	.....	.....	....
4	0.798	35,720	24.5
5	0.505	33,750	22.5
6*	.....	.....	....
7	0.798	33,080	21.0
8	0.505	34,600	24.0
Average ...		36,866	25.3

*Specimen broke in lathe.

Alloy No. 2.—Copper-Tin, New Metal; Pigged and Remelted. Temperature of Metal, 2,300 Degrees Fahr.

1	0.505	51,250	42.5
2	0.505	50,300	40.5
3	0.798	40,660	23.5
4	0.505	50,400	39.0
5	0.798	33,740	14.0
6	0.798	28,560	9.5
7	0.798	34,200	16.0
8	0.505	40,550	28.0
Average ...		41,201	26.6

Alloy No. 3.—Copper-Tin; New Metal; Not Remelted. Temperature of Metal, 2,100 Degrees Fahr.

1	0.505	44,150	42.0
2	0.505	38,250	30.0
3	0.798	36,460	27.0
4	0.505	40,350	31.0
5	0.505	36,600	37.0
6	0.505	37,200	30.0
7	0.505	27,050	17.5
8	0.505	39,100	40.0
Average ...		37,395	31.8
Green-sand mold, average....		35,190	30.5

Alloy No. 4.—Copper-Tin; New Metal; Not Remelted. Temperature of Metal, 2,200 Degrees Fahr.

1*	0.505	27,200	2.5
2	0.505	42,500	15.0
3	0.798	32,040	6.0
4	0.505	39,700	11.0
5	0.505	34,250	11.0
6	0.505	20,700	1.5
7	0.505	32,250	7.5
8	0.505	37,750	14.0
Average ...		34,170	9.4
Green-sand mold, average....		33,502	11.0

*Defective test; not included in averages.

Alloy No. 5.—Copper-Zinc; New Metal; Not Remelted. Temperature of Metal, 1,800 Degrees Fahr.

1	0.505	39,450	34.0
2	0.505	38,000	29.0
3	0.505	43,180	42.0*
4	0.505	34,300	25.5
5	0.505	41,950	46.0
6	0.505	41,450	40.0
7	0.505	42,750	47.0
8	0.505	43,300	49.0
Average ...		40,548	39.0

*Defective for diameter = 0.798 in.

Alloy No. 6.—Copper-Zinc; Alloy No. 5 Remelted. Temperature of Metal 1,840 Degrees Fahr.

1	0.505	49,250	40.0
2	0.505	44,000	25.0
3	0.798	48,200	37.0
4*	.....	.....	....
5	0.505	50,000	48.0
6	0.505	49,250	47.0
7	0.505	49,800	45.0
8	0.505	50,000	46.0
Average ...		48,650	41.1
Green-sand mold, average....		48,421	35.0

*Defective test.

Alloy No. 7.—Copper-Zinc; New Metal; Not Remelted. Temperature of Metal, 2,100 Degrees Fahr.

1	0.505	31,450	39.5
2	0.505	30,850	44.0
3	0.798	31,400	37.0
4	0.505	32,200	52.0
5	0.505	29,000	52.0
6*	.....	.....	....
7	0.505	28,900	55.5
8	0.505	31,700	44.0
Average ...		30,786	46.0
Green-sand mold, average....		29,435	47.0

*Defective test.

Alloy No. 8.—Copper-Zinc; New Metal; Pigged and Remelted. Temperature of Metal, 1,800 Degrees Fahr.

1	0.505	69,150	32.5
2 (not cast)..	.....	.....	....
3	0.698*	69,990	29.0
4 (not cast)..	.....	.....	....
5	0.798	68,880	29.0
6	0.798	31,780	1.5†
7	0.798	68,740	29.0
8	0.505	67,850	25.0
Average ...		68,922	28.8

*Specimen defective for diameter of 0.798 in.; was turned down to 0.698 in.

†Defective test; not included in averages.

Alloy No. 9.—Copper-Zinc; New Metal; Pigged and Remelted.

1	0.447	73,885	26.0
2	0.505	73,200	26.0
3	0.798	73,100	24.0
4	0.798	72,800	26.0

Alloy No. 10.—Copper-Tin; New Metal; Not Remelted. Temperature of Metal, 2,100 Degrees Fahr.

1	0.505	33,000	16.0
2	0.505	40,600	28.5
3	0.798	31,480	16.0
4	0.505	28,950	10.0
5	0.505	25,750	12.5
6	0.505	27,150	16.0
7	0.505	20,600	9.0
8	0.505	40,150	48.0
Average ...		30,960	19.5
Green-sand mold, average....		32,070	20.2

one attempt was made to make a block of manganese bronze pulling about 80,000 pounds per square inch. This casting was a failure due to the little shrink holes occurring throughout the casting. One test was good, No. 1, which gave a tensile strength of 79,500 pounds per square inch and an elongation of 24 per cent.

The block for alloy No. 9 was not finished and is inserted in Table II because the analysis was made.

The alloys used were made by melting the copper under charcoal, then adding the zinc, tin and lead in the order named. The temperature of the melted copper was allowed to become sufficiently high to cause the zinc to flare when added in the case of those alloys requiring a large amount of zinc. To the alloys high in tin, 1 ounce of 15 per cent phosphor-copper was added for every 100 pounds of metal after the other metals had been alloyed, the object being to introduce sufficient phosphorus to remove the oxides and leave a trace of phosphorus in the alloy.

Manganese bronze was made by introducing an alloy of iron, manganese and tin into the melted copper when sufficiently hot. This alloy, which is made by melting together iron and ferro-manganese, has an approximate composition of 54 per cent iron, 21 per cent manganese and 25 per cent tin. When this mixture is melted the tin is introduced to lower the melting point. The amount of this alloy introduced depends upon the percentage of iron desired in the bronze. Tin is added later with the zinc to keep the percentage of tin at 0.8. After the above alloy had dissolved in the copper the aluminum was added and then the zinc and tin. The manganese bronze was pigged before being used again.

Pyromeier Readings

In taking pyrometer readings, no attempt was made to get the casting temperature at the mold, because the pyrometer in use was a base-metal couple that was not sufficiently sensitive to give quick accurate readings; also because pyrometer readings are best made at the furnace, on account of the necessity of removing the metal from the furnace when the proper temperature has been reached. This procedure does not allow the metal to overheat or soak (that is, to remain in the furnace an unnecessary length of time), which injures the alloy. In Table II the temperature given is the temperature taken at the furnace.

On comparing the different tests we can conclude that the 88-10-2 test specimen as shown in Fig. 1 is convenient to use on copper-tin alloys. Incidentally, it may be noted that the average strength as given in Table II is approached by the strength of specimens Nos. 3 and 8 for the copper-tin alloys, and by No. 8 for the copper-zinc alloys. The 88-10-2 specimen with its narrow gate was attached to a block of manganese bronze with no success. The gate was then widened to the thickness of the test specimen at the middle as used on the blocks for alloys Nos. 8 and 9. The adopted test specimen for manganese bronze (0.505 inch diameter) took the form shown in Fig. 4, *b*. The 88-10-2 specimen was not successful with brass due to small cracks forming in the specimen. These small cracks were not noticeable until the specimen was tested. The rate of freezing appears not to affect the copper-zinc alloys to as great an extent as the copper-tin alloys. The strength of alloy No. 2 varied from a tensile strength of 51,250 to 28,560 pounds per square inch, while that of alloy No. 7 varied from a strength of 31,700 to 29,000 pounds per square inch. With this copper-zinc alloy no cracks developed in the test specimens Nos. 1, 2, 3 and 4.

Considering a test specimen to represent the strength of a copper-zinc alloy, we can choose such a specimen as Nos. 5 or 6 for a diameter of 0.798 inch, or No. 8 for a diameter of 0.505 inch (the specimen shown in Fig. 4, *b*, is identical with No. 8). But when the copper-tin alloys are considered we can not make a choice. In a gear blank made from 88-10-2 metal, the surface of the metal is cut away to form the teeth of the gear. It is evident that the strength of the teeth could not be represented by test specimens Nos. 1, 2, 3 and 4. If a bar of the same metal is turned down to the size of a bolt, the designer's calculations must be based on the strength of the metal represented by specimens Nos. 5 and 7.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Brass Foundry Sand

What kind of sand is used for brass work and kindly advise us approximately at what temperature molten brass should be poured? What alloy should be used for small connecting rods?

Sand suitable for brass molding is found in many parts of the United States and some shops are located with sand banks in close proximity, while others must ship it from a considerable distance. If there is any doubt about your ability to identify the sand for brass work, it would be advisable for you to obtain it from a dealer in foundry supplies at the nearest point of shipment. For small castings a fine sand is required and for castings weighing over 20 pounds a No. 2 grade is suitable. In the former case merely specify fine brass sand and in the latter, No. 2 brass sand. If there is a stove foundry in your vicinity, the sand employed in this shop will be satisfactory for your use.

The melting points, and consequently the pouring temperatures of copper-alloys vary according to their composition. The more white metal alloys contain, the lower will be their melting points. Red brass has a lower melting point than gun metal and the melting temperature of yellow brass is lower than that of red brass. It is more advisable to pour hot than cold. Gun metal should be poured at a temperature not less than 2,000 degrees Fahr.; red brass 1,850 degrees Fahr. and yellow brass 1,650 to 1,700 degrees Fahr. If a pyrometer is not available, pour either gun metal or red brass when the molten metal appears bright in place of dead and thick, and pour strongly. Yellow brass will smoke and in the case of thin work, the metal will cause an iron rod held therein to vibrate when the temperature is right.

An alloy for connecting rods follows: Copper, 88 per cent; tin, 7 per cent; lead, 2 per cent and zinc, 3 per cent.

The mineral bauxite is used on a large scale in the manufacture of the artificial abrasive alundum at Niagara Falls. This abrasive is made in the electric furnace by fusing calcined bauxite.

Ornamental Castings

Kindly give the formula of a cheap, soft, pliable brass mixture, suitable for flat work, such as placques, profiles of heads, etc. We would like to know how to melt these alloys, the method of adding the separate metals step by step and how best to clean these castings. The method of finishing should be outlined, as well as the process whereby the greenish color or tint is obtained in the background in relief.

For making ornamental bronze castings the following alloy will be found satisfactory: Copper, 90 per cent; tin, 5 per cent; zinc, 5 per cent, and lead, 0.5 per cent. First make an estimate of the amount of metal required for the particular casting to be made and this will decide how much of the alloy it will be necessary to produce. If one-half or one-fourth of the foregoing formula is required, divide by one-half or one-fourth, as the case may be. If only a small amount of metal is necessary, a simple way of figuring the mixture is to imagine the formula is given in ounces instead of pounds. This gives us 5 pounds 10 ounces of copper, 5 ounces of tin, 5 ounces of zinc and ½ ounce of lead, a total of 6¼ pounds, and by doubling this amount a total of 12½ pounds is arrived at. Select a crucible of suitable size to accommodate the metal required and place it in the furnace on a bed of coke about 6 inches thick, centering the crucible so that the space for the fuel between the furnace walls and the crucible is of uniform width. Fill up this space with fuel to the top of the crucible. Then charge the latter with the copper, placing in the bottom 1 ounce of salt per 100 pounds of metal and several handfuls of charcoal broken to pea size. The furnace then should be closed and after about 20 minutes it can be opened to see how the melting is proceeding. It may be necessary occasionally to add more fuel, or to push down the copper, or to add more charcoal, the idea being to keep the copper covered with charcoal to avoid undue oxidation.

When the copper is melted, allow it to become sufficiently hot to appear blue and limpid when the charcoal is pushed aside and at this stage add the zinc, which should have been warmed previously. Pick up the zinc in the tongs and push it down into the copper and stir well. Next add the tin and lead with further stirring of the alloy. The molds then should be ready to cast. The pot is removed from the furnace, the surface is skimmed with a piece of flat iron with a crooked end and this iron also is used when pouring the bronze to hold back the dross or coal on the surface of the metal, thereby preventing it from entering the mold. Always pour strongly and have the molds well weighted or secured otherwise against the hydrostatic pressure of the metal which would force them open and permit the metal to spill out on the floor. If the floor is concrete, scatter molding sand liberally around the molds when pouring so that if they spring a leak the metal will not come in contact with the cement. Unless this is done an explosion will result. If light castings are made the molds should be shaken-out as soon as the pouring heads have become black, snatching the castings from the sand and plunging them into water. This latter procedure will remove the sand and will impart a bright, clean appearance to the castings. The gates next are cut off and after brushing the castings with a steel scratch brush, the work of the brass foundry will be finished.

Red Metal for Patterns

We would like to have a good red metal mixture for pattern work which will cast clean and will also be strong and file and scrape easily. We are now using 10 pounds of copper, ¾ pound of tin, 2 ounces of lead and ¼ pound of zinc.

The trouble with the mixture given is that it is too low in lead to cut easily. It would be greatly improved by trebling the amount of lead and decreasing the copper by the amount of lead added. The following alloy also can be recommended: Copper 86½ pounds; tin, 5 pounds; lead, 5 pounds, and zinc, 3½ pounds.

Nickel Bronze Mixtures

Kindly furnish us with a good mixture for nickel bronze and German silver.

The composition of nickel bronze varies with the service required of the metal. The following alloy is recommended for gears: Copper, 87 per cent; tin, 9 per cent; phosphor tin, 1 per cent, and nickel, 3 per cent. Add the nickel in the bottom of the crucible with the copper.

For German silver the following alloy is considered satisfactory: Copper, 61.7 per cent and nickel, 18 per cent; melt together under a flux of charcoal and glass, add 0.25 per cent of manganese copper and follow this alloy with 20 per cent of Bertha or Horsehead spelter.

Mixture For Rolling Mill Brasses

Will you kindly furnish us a formula for rolling mill brasses for use in a wire mill? The brasses are 10 inches in diameter and the rolls revolve at a speed of 350 to 400 revolutions per minute. These rolls are cooled by water and by heavy grease. We have been using 10 pounds of copper and 1 pound of tin in our mixture, but we find that the brasses heat and wear out quickly. In your opinion, would lead aid in keeping these brasses cool?

The reason that your alloy does not prove satisfactory is due to the fact that it does not contain lead. The latter metal is an essential ingredient of all bearing alloys. The following instance will serve to illustrate the importance of lead in this connection. One company operating heavy board drop hammers noted considerable difference in the wearing properties of the bronze bushings supplied by two different foundries. In one case the bushings would last only a few weeks, while the other bushings gave satisfactory service. To ascertain, if possible, the cause of this difference in the lives of the bushings furnished by the two different companies, analyses were made and No. 1 contained copper, 90.28 per cent; tin, 9.31 per cent, and lead, 0.37 per cent. No. 2 contained copper, 87.77 per cent; tin, 7.38 per cent, and lead, 4.26 per cent; Alloy No. 2 gave the best results and was adopted, the following specifications having been prepared for this work: Copper, 87 per cent; tin, 8 per cent, and lead, 5 per cent. This also is the alloy that we recommend for the purpose outlined.

In the majority of bearing alloys the lead is much higher than 5 per cent. In the case of the bushings for the drop hammers referred to the load that had to be raised was 3,000 pounds, and, therefore, high lead was not considered advisable. In the case of mill brasses more than 5 per cent of lead may be used, according to the special requirements of each individual case as determined by experience and common sense. As a guide to the preparation of another alloy in the event that the one given does not prove entirely satifsactory, the following formulas might prove of service:

Damascus bronze, according to analysis, contains copper 76.45 per cent; lead, 12.60 per cent, and tin, 9.22 per cent.

Cornish bronze: Copper, 77.83 per cent; lead, 12.40 per cent; tin, 9.60 per cent, and phosphorus, trace.

Bullock's bearing alloy for heavy engine bearings: Copper, 100 pounds; tin, 14 pounds; lead, 6 pounds, and phosphor copper, 3 pounds.

Convention of American Electro-Platers' Society

Report of the Proceedings at the Annual Meeting of This Organization Recently Held at Chicago

THE second annual convention of the American Electro-platers' Society opened at Chicago on Thursday, June 4, in the new Fort Dearborn hotel, the convention headquarters. The first session was called to order at 10 a. m., Thursday, by President George Hogaboom, with a good attendance of delegates from the different states and Canada. The society has grown from seven branches in 1913 to 14 branches in 1914, with a total membership of about 700. The finances of the body are in a sound condition and the prospects for a prosperous future are bright. The Thursday morning session was turned over to the Chicago members and the presidents of various branches responded as called upon. E. T. Wheelock, representing the Panama-Pacific International Exposition, spoke at some length and cordially invited the society to hold the 1915 convention in San Francisco during the exposition. Mr. Lynn, representing the

J. H. HANSJOSTEN,
President, American Electro-Platers' Society

W. S. BARROWS,
First vice president, American Electro-Platers' Society

United States Chamber of Commerce, also addressed the members. It was unanimously decided, however, not to consider the invitations extended. A large amount of work was disposed of at the Thursday afternoon session. Thursday evening was devoted to a discussion of the following papers: "To Pickle or Not to Pickle", by J. H. Hansjosten, Chicago; "Standardization", by R. Davenport, Detroit; "He Who Renders Service is Rewarded", by L. Schmidt, Chicago; "The Production of Silver Deposit Work", by George B. Hogaboom, New Britain, Conn. These papers called forth a free and good-natured discussion and proved very instructive.

Election of Officers

Friday morning's session was presided over by Second Vice President Walter S. Barrows, and several amendments to the constitution were passed and a spirited session enjoyed. Friday afternoon's session was enlivened by several more amendments and the election of officers for the ensuing year.

The newly elected officers follow:

President—J. H. Hansjosten, Kokomo, Ind.

First Vice President—W. S. Barrows, Toronto, Can.

Second Vice President—H. H. Williams, St. Louis.

Secretary — Walter Fraine, Dayton, O.

Treasurer—John E. Stirling, New York.

Editor—H. E. Willmore, Chicago.

Friday evening papers were read and discussed as follows: "Visiting a Modern Plating Plant", by J. Birnbaum; "Electro-Galvanizing", by L. Schmidt, Chicago; "Talk on Current Regulation", by S. Hueuerfauth, Chicago; "Talk on Deposition of Lead", by L. Schulte, Chicago; "The Plater of Tomorrow", by H. J. Ter Doest, Akron, O.; "The Electro-Plating of Non-metallic Surfaces", by Emil Nordblom, Toronto, Can.

The discussions which followed these papers were convincing evidence of the value of this portion of the convention, every member being intensely interested in some point or process.

During the entire convention a large display of various goods finished by the members was made in the corridor of the mezzanine floor, and eager eyes were constantly feasting on the beautiful colors and combinations. Conspicuous among these exhibits was a large cash register placed by Walter Fraine, foreman plater for the National Cash

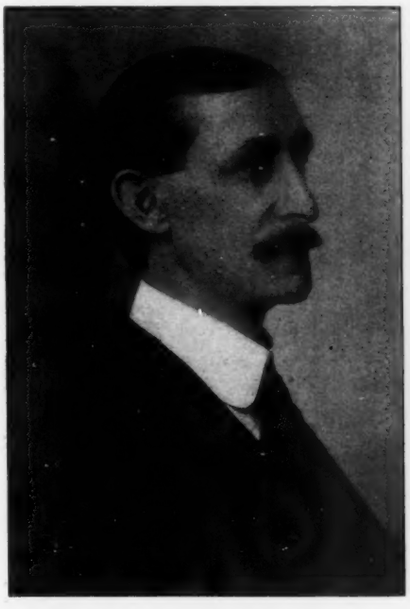
H. H. WILLIAMS,
Second vice president, American Electro-Platers' Society

Register Co., Dayton, O. The register was expressly built for the convention and was an example of the interest this enterprising firm is taking in the society. An Oliver typewriter finished in black nickel and

wood and iron coated with nickel by spraying were also very attractive exhibits. Medals, medallions and buttons beautifully shaded in bronze were to be seen. Hardware finishes in countless variety, in fact, everything from a fish hook to an automatic bookkeeper, could be found to illustrate the artistic taste and ability of the electro-plater.

Saturday morning was given over to visiting various plating plants, with luncheon at the Briggs House. Harry E. Starrett tendered the delegates a noonday luncheon on Friday at the Hardware Club of Chicago. The host was in a very happy mood and wit and humor characterized the brief speeches. At 1:30 Saturday afternoon the delegates left the hotel in automobiles escorted by E. Lamoureaux and were shown the beauties of Chicago parks, boulevards and avenues. Upon their return a short session was held during which a fine ebony gavel was presented to Past President Hogaboom and the society held its final business meeting. The next convention is to be held in Dayton, O., during the first week in June, 1915.

The final session was in the form of a buffet luncheon at the Dearborn Hotel, Saturday evening. This portion of the program was thoroughly enjoyed by many who were unable to attend the earlier proceedings. Many of the delegates departed for



WALTER FRAINE
Secretary, American Electro-Platers' Society

their homes on Saturday evening, while a few remained over Sunday to see more of the Windy City or visit friends. The convention was a decided success and the work accomplished there will mean much to the members during the coming year. One change which will no doubt be welcomed will be the combining of the monthly bulletin and quarterly review into a monthly journal, thereby giving the members more frequent

GEO. B. HOGABOOM,
Retiring president, American Electro-Platers' Society

opportunities to publish papers and read the transactions at the various branch meetings.

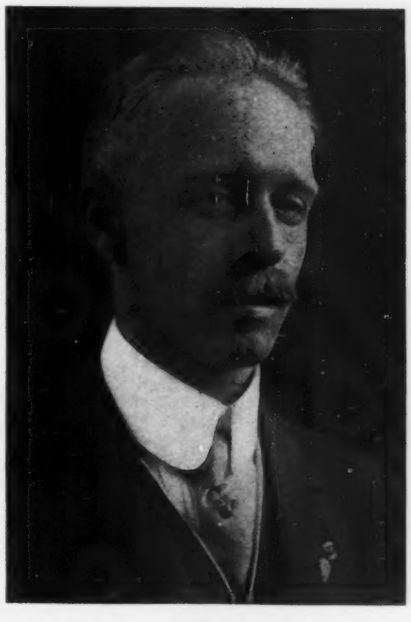
Experimental Plating Plant

The Canadian Hanson & Van Winkle Co., Toronto, Ont., recently has installed a modern electroplating and experimental plant at its Toronto works for the use of its customers. The plant is complete in every detail, making it posible to give practical demonstrations in all classes of electroplating, employing the most modern methods known today. The plant was designed and installed by W. R. King, of the Hanson & Van Winkle Co., Newark, N. J. Electric power is supplied by a generator set, the dynamo being direct-connected by a flexible coupling to a motor, both units being mounted on a sub-base. In this connection it is pointed out that in plating operations it is important to employ a motor generator set in place of a dynamo belted from the shafting and operating other machinery. The generator set permits the plant to be operated independently. In this plant individual motors are employed for operating other equipment, such as mechanical plating apparatus, polishing machinery, brush lathes, air compressors for the lacquer outfit, etc.

A special feature of this installation consists of the use of mechanical devices for both polishing and plating, thereby reducing to a minimum the handling of the work. In recent years mechanical plating has made rapid strides and this, with the addition of the burnishing barrel, has greatly reduced the cost of electroplating. This demonstrating plant has facilities for doing any class of electroplating, oxidizing and for finishing work in any desired style, the lacquer room being equipped with air compressors and air-operated brushes, which make it possible to impart metal finishes or special lacquer finishes from the complete line of lacquers manufactured by this company.

The heating of the plant has been carefully considered and the system is so arranged that steam can be taken from the main line, or in case the boilers are not in operation a steam generator has been provided for independent service. The plant also is equipped with voltmeters and ammeters so that the exact amount of current being used for each tank can be quickly determined by the plater.

In this connection it is interesting to note the rapid advances which have been made in the design of plating generators in recent years. The efficiency of the modern plating plant depends, to a large extent, upon the choice of a suitable dynamo. Many years ago the current was obtained from batteries, but more recently the motor generator set has replaced batteries for this purpose. The first generator that would give a permanent current of electricity consisted of steel magnets and was an in-



JOHN E. STIRLING,
Treasurer, American Electro-Platers' Society

vention based on the discovery made by Faraday. This machine was perfected and first operated successfully by Prime & Son at their silverware works, Birmingham, Eng., in 1844. This was the forerunner of the present dynamo used

for electroplating. This machine was of somewhat large proportions, having been 5 feet long, 2 feet 6 inches wide and 5 feet high. The power required to operate it was ten times as great as that needed at the present time to drive a modern generator. The amount of material deposited by the original generator in a given time was only one-tenth the amount that can be deposited by a modern machine.

Subsequently other generators were built until the present type was evolved. The interpole generator developed by the Hanson & Van Winkle Co. recently, is equipped with graphitized, self-adjusting non-sparking brushes which enable the plater to regulate the current to extremely close limits which never vary. These generators are all direct current and are built from 50 to 10,000 amperes both in two and three-wire systems. At this plant also will be demonstrated the new bright nickel solution made from nickel salts perfected by this company. The use of this solution makes it possible to plate on brass, copper, white metal, iron, etc., and to bring out the work with a brilliant luster without the aid of buffing.

Handling Steel Castings With a Lifting Magnet

The various applications of the lifting magnet is well illustrated by the work done by this device in the plant of the Ohio Steel Foundry Co., Lima, O. The magnet not only is employed for handling castings and for conveying them from one part of the shop to another, for loading and unloading

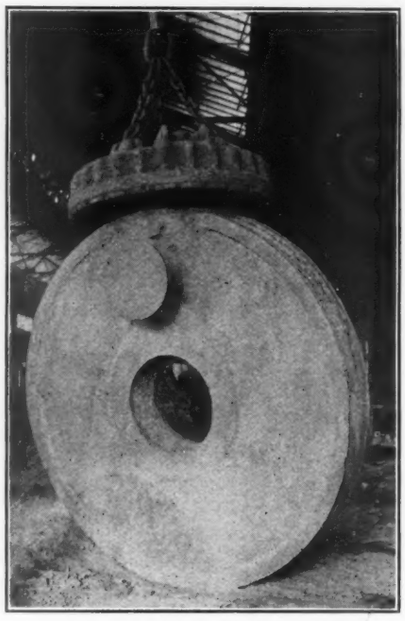


FIG. 1—MAGNET HANDLING CRANK DISC

cars, etc., but is utilized also for shaking-out castings and for conveying them from the shake-out heap to the cleaning department.

The magnet, which is of the Cutler-Hammer type, is suspended from a crane installed by the Toledo Bridge & Crane Co., Toledo. In addition to handling this magnet, the crane is equipped to handle a Haywood, 3-line, 1½ cubic yard grab bucket.

In the accompanying illustrations, Fig 1 shows the magnet handling a 30,000-pound crank disc, ten of which were furnished the Hooven, Owens, Rentschler Co., Hamilton, O., for five 6,000-horsepower combination steam and gas engines for the Ford Motor Car Co., Detroit.

Fig. 2 shows this 63-inch magnet lifting a 9,300-pound vanadium steel locomotive frame, 28 of which were furnished the Lima Locomotive Corporation, Lima, O., for 14 Delaware, Lackawanna & Western locomotives.

Sanitary Drinking Fountains

With the advent of the summer months, greater interest is manifested among foundrymen in the installation of sanitary drinking fountains and in many states their use is made compulsory. In most shops these fountains are conveniently located at various points to permit the operatives to quench their thirst by walking only a short distance from their floors and this arrangement has been found exceedingly satisfactory.

The Rundle-Spence Mfg. Co., Milwaukee, recently has issued a booklet devoted to its extensive line of drinking fountains for installation in industrial plants and various types are illustrated, those most frequently installed being provided with china bowls mounted on galvanized iron pedestals. Special cooling systems also are provided for use with these fountains and a combination cooler fountain is shown which consists of a china bowl, nickel-plated brass bubbling head and an ice barrel in which the water is cooled in a galvanized iron pipe coil. This equipment frequently is installed in foundries requiring a limited number of fountains.

FIG. 2—MAGNET LIFTING LOCOMOTIVE FRAME

Advance Programs of Foundrymens' Conventions

Outline of the Sessions and Entertainment Features of the American Foundrymen's Association and the Institute of Metals

PREPARATIONS are rapidly being completed for the celebration of "Founders' Week" at Chicago, from Sept. 5 to 11. Simultaneous annual meetings of the American Foundrymen's Association, American Institute of Metals and the Associated Foundry Foremen will be held, beginning Monday, Sept. 7, while the great display of foundry equipment and supplies will be opened for the inspection of visiting foundrymen on Saturday, Sept. 5.

Both the American Foundrymen's Association and the American Institute of Metals have outlined programs of practical and technical value and a large number of papers and addresses have been promised, which treat of every conceivable phase of foundry work. The tentative program issued by the American Foundrymen's Association provides for the grouping of papers and addresses on similar subjects, to enable the visiting members to attend any session or sessions in which they are directly interested. At the opening meeting, on Tuesday morning, following the formal addresses, the subject that will be considered will be "Safety in Foundry Operation" and in the afternoon papers on "Foundry Construction and Equipment" will be presented. Wednesday morning a joint meeting will be held with the American Institute of Metals, and this session will be known as a "Cost Congress", at which every problem affecting the cost of foundry operations will be considered. Not only will cost systems be discussed, but the methods in vogue in the most important jobbing shops throughout the country for making estimates on new work also will be presented for consideration. This subject is of the utmost importance to every foundryman, and the report on "Estimating the Selling Price of Castings" will prove of great interest to every casting manufacturer. Several papers and addresses on "Efficiency Work in Foundry Operations" also will be presented.

The entire Wednesday afternoon meeting will be devoted to a consideration of "Malleable Foundry Practice" and the subject will be discussed from both the practical and technical viewpoints. "Steel Foundry Work" will be considered on Thursday morning, and Senior Vice President R. A. Bull, who is preparing the program for this session, promises a large number of papers treating of various phases of foundry practice. The last professional session will be held on Thursday afternoon and will be devoted entirely to the consideration of "Gray Iron Foundry Practice".

The American Institute of Metals also has issued an advance program, which promises an unusually interesting meeting. Tuesday and Wednesday mornings joint sessions will be held with the American Foundrymen's Association, but separate meetings will be conducted Tuesday afternoon, Thursday morning and afternoon, and Friday morning. The Associated Foundry Foremen also contemplate holding several meetings for the consideration of papers on practical foundry work.

An elaborate entertainment program has been outlined, which includes a banquet for the members of the Associated Foundry Foremen at the La Salle hotel on Monday night, luncheon for the ladies at the Stockyards Inn, Wednesday noon, inspection of the stockyards Wednesday afternoon, trip to the White City Wednesday evening and separate banquets for the members of the American Foundrymen's Association and the ladies at the La Salle hotel, Thursday evening.

That the exhibition of foundry equipment and supplies, and machine tools, to be conducted under the auspices of the Foundry and Machine Exhibition Co., at the International Amphitheater, will be on equally as extensive a scale as last year, is indicated by the large number of space reservations already made. Several manufacturers have increased their space allotment over that occupied last year, and the number of exhibitors promises to exceed last year's total.

Tentative Program A. I. M. Convention

Monday, Sept. 7.
Registration, LaSalle hotel.
Tuesday, Sept. 8, 10 a. m.
Joint meeting with A. F. A.
Tuesday, 2 p. m.
Professional session.
Wednesday, Sept. 9, 10 a. m.
"Cost Congress", joint session with A. F. A.
Wednesday Noon.
Ladies' luncheon at the Stockyards Inn.
Wednesday Evening.
Trip to the White City.
Thursday, Sept. 10, 10 a. m.
Professional session.
Thursday, 2 p. m.
Professional session.
Friday, Sept. 11, 10 a. m.
Final business session.

Tentative Program A. F. A. Convention

Monday, Sept. 7
Registration at the LaSalle hotel.
Tuesday, Sept. 8, 10 a. m.
Joint meeting with the American Institute of Metals and Associated Foundry Foremen at the LaSalle hotel. Formal addresses to be followed by a number of papers on "Safety Work in Foundry Operations".
Tuesday, 2 p. m.
Individual session of the American Foundrymen's Association at the LaSalle hotel. Papers will be presented on "Foundry Construction and Equipment."
Wednesday, Sept. 9, 10 a. m.
Joint meeting with the American Institute of Metals at the Saddle and Sirloin Club, adjacent to the International Amphitheater where the Foundry and Machine Exhibition Co. will conduct its big exhibition of foundry equipment and supplies.
This session has been termed a "Cost Congress". Papers will be read and addresses delivered on the necessity of obtaining accurate costs in foundry operations. How to make bids for work will be discussed and a report on this all-important subject will be submitted. The cost committe of the American Foundrymen's Association will present its annual report, suggesting a revision of the Standard Foundry Cost System and a number of papers will be read on "Efficiency in Foundry Operations".
Wednesday Noon.
Ladies' Luncheon at the Stockyards Inn.
Wednesday, 2 p. m.
Entire session devoted exclusively to the discussion of "Malleable Foundry Practice".
Wednesday Afternoon
Stockyards inspection.
Wednesday Evening.
Visit to the White City.
Thursday, Sept. 10, 10 a. m.
This session will be devoted to "Steel Foundry Practice", the program being prepared by R. A. Bull, senior vice president of the American Foundrymen's Association.
Thursday, 2 p. m.
This session will be devoted exclusively to the presentation of papers and the discussion of "Gray Iron Foundry Practice".
Thursday Evening.
Banquet at the LaSalle hotel, for members only. Speaking will be limited to one or two addresses by speakers of national fame.
Banquet for the ladies at the LaSalle hotel.

The Excelsior Tool & Machine Co., East St. Louis, Ill., will increase the capacity of its plant by the erection of an extension to its machine shop, bids for which are now being received. The building will be of fireproof construction.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade.

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Oil Your Molding Machines

MANY FOUNDRYMEN could profitably take a leaf from the experience of the farmers of this country in regard to the care of machinery—particularly molding machines. The time is not far past when the farmer left his binder in the field at the close of the harvesting season without even a canvas cover to protect it from the ravages of winter. But he soon found that this necessitated the purchase of a new machine sometimes before the notes given in payment for the old one had all matured. Learning, therefore, from bitter experience, the farmer of today cares for his machines in a rational manner. As a result, the average effective life of agricultural implements has been at least doubled. A large number of foundrymen today treat their molding machines much as the farmer of ten years ago cared for his binders. But just because a machine is sturdy and will stand up against abuse is no reason why it should be neglected. A little oil now and then on the working parts and an occasional cleaning will work wonders in prolonging the life of any molding machine. Particular attention should be given the parts which constitute the drawing mechanism, in order to avoid excessive wear and prevent rust or corrosion which will interfere with the smooth action of the machine, resulting in improperly drawn patterns and inaccurate molds. On many of the larger machines, the important shafts and bearings are provided with compression grease cups, which should be screwed down and refilled at regular intervals. In filling grease cups, be careful to prevent the sand on the floor from getting mixed with the grease. Bright parts, machine-finished surfaces, etc., should be occasionally wiped off with an oily rag, to prevent rust. In brief, treat your molding machines as you would any piece of good machinery and you will add money to your bank account.

Trade Outlook

HALF OF 1914 has passed into history and most foundrymen view the turn of the year with hope that the forthcoming six months may bring forward better conditions. Some basis for this hope is found in the rather notable increase in pig iron buying, which took place during the last week in June. Apparently a large number of foundries have enough business in sight to justify laying in moderate stocks of raw material. As usually is the case in dull times, the jobbing foundries have suffered most severely from the curtailment in orders and many plants will shut down for two weeks in July. Pig iron prices show little change, owing largely to the fact that they have reached and in some centers crossed the cost line. No. 2 foundry is quoted $13.90, Pittsburgh; $14.25, Cleveland; $14, Chicago; $14.75, Philadelphia, and $10.25, Birmingham. Malleable is quoted $14, Chicago, and $13, Buffalo; Lake Superior charcoal is $15.75, Chicago.

New Equipment for the Foundry and Pattern Shop

Sand-Handling Apparatus—Power Squeezers—Protective Goggles and Masks—Charging Floor Elevators—Electric Vibrator—New Sand Sifter

APPRECIABLE economies in handling sand have been realized in the steel foundry of the Curtis Pneumatic Machinery Co., St. Louis, through the installation of a special charging machine for loading the sand mills, together with devices for automatically and evenly spreading molasses, oil, dextrine and resin on the sand as it is being mixed. The Curtis company operates two sand mills in its steel foundry and at the present time one man carries all of the sand to both mills and a man is employed at each mill to keep it running at its maximum output. The total force, therefore, includes only three men where six were required before the charging machine was installed. The sand is delivered from the mill into buckets which are picked up by the traveling crane and distributed to the various floors in the foundry.

The general features of the charging machine are shown clearly in Figs. 1 and 2. The machine is an adaptation of the blast furnace skip hoist idea and consists of an inclined frame in which a heavily constructed steel bucket rides under the control of a pneumatic cylinder. When the bucket reaches the top of its stroke it is automatically dumped, as shown in Fig. 2. While the mill is grinding a charge of sand, the attendant fills the machine and 10 seconds after the mill is emptied with the unloading plow, a new charge is in place. It is said that this saving in loading time increases the capacity of the mill about 25 per cent. As soon as the new charge is in place, the operator pulls the lever which controls the pneumatic molasses measurer and the molasses is distributed evenly in small streams over the sand. This is said to save a large amount of molasses and also to shorten the milling time necessary to produce a thorough mixture, as compared with the practice of dumping a bucket of molasses into the mill. A vibrating spreader is used to distribute the dextrine or resin over the sand and less of these substances are required due to the more uniform spreading.

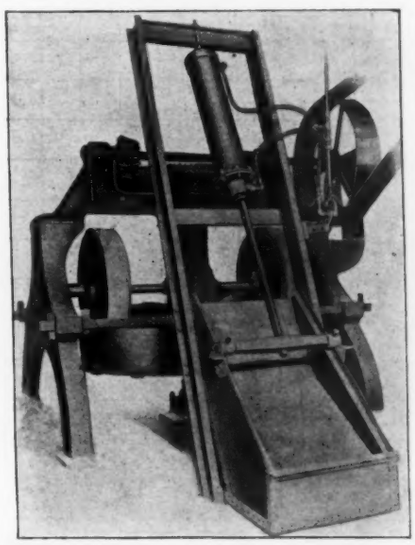


FIG. 1 — PNEUMATIC CHARGING MACHINE IN LOADING POSITION

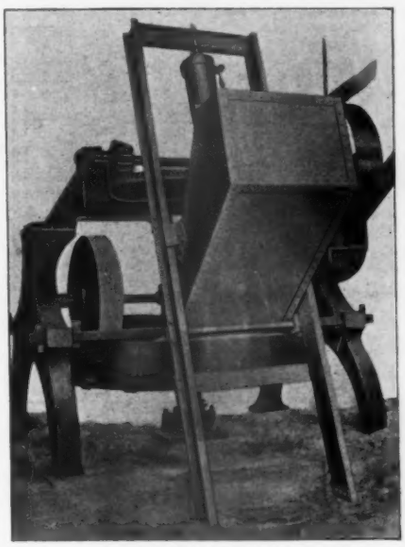


FIG. 2—DUMPING A CHARGE OF SAND INTO THE MILL

Sand Bins are Convenient

The sand bins are located immediately behind the charging machines, as shown in the plan of the Curtis Pneumatic Machinery Co.'s layout, Fig. 4. These bins are filled by a bucket which is carried on an I-beam trolley that extends from the sand shed into the foundry. In the sand shed the trolley beam is placed at such a height that the bucket is only a few inches above the ground in order to save labor in filling. The bucket is raised to the proper height to discharge the sand into the bins before it enters the foundry by means of the pneumatic elevator shown in Fig. 3.

Before these improvements were installed, the mill was emptied of a mixture of sand and then reloaded, one shovelful at a time. While the mixture was being ground, the attendant was practically idle until the time arrived to unload the charge with the unloading plow. When the pneumatic charger is used, the time that the attendant would ordinarily be idle can be utilized in shoveling the proper amount of green sand, burnt foundry sand, etc., into the charging bucket. As soon as the mixture has been unloaded, the charger dumps the proper amount of sand into the mill without delay. The hoist in the trolley track, Fig. 3, also is claimed to save considerable time and money inasmuch as one machine does all of the hoisting necessary in handling several buckets and trolleys.

Death of Charles Herman

Charles Herman, inventor of the jar-ramming molding machine, died at his home, Zelienople, Pa., on Wednesday, May 20. Born in Stargart, Germany, in 1844, he emigrated to this country in 1865 and for approximately ten years he resided in New York City. Later he removed to Pittsburgh and was associated with Kinzer & Jones, founders

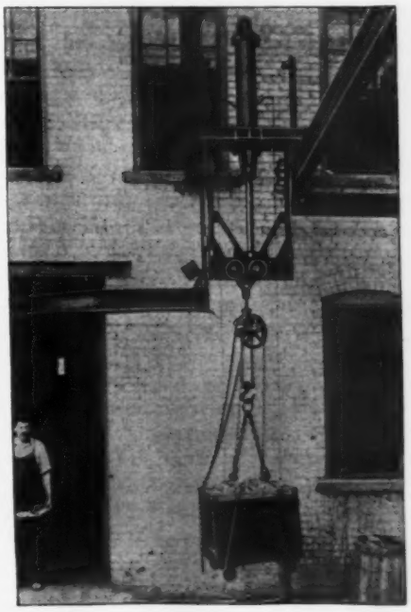


FIG. 3—PNEUMATIC HOIST IN TROLLEY TRACK

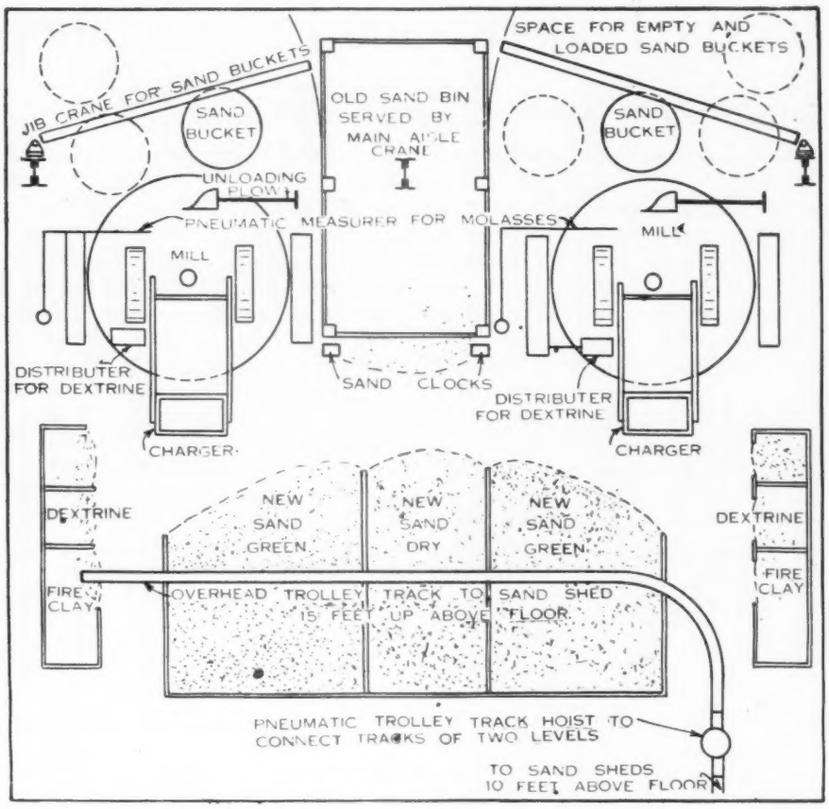


FIG. 4—PLAN OF SAND MIXING EQUIPMENT IN CURTIS STEEL FOUNDRY

and machinists. This company was an extensive manufacturer of pipe balls, which were tested for accuracy by steel gage and, owing to the hand-ramming method then employed in this foundry, considerable loss was entailed, due to the lack of uniformity of these castings. As a result of these losses Mr. Herman experimented with various types of molding machines for making molds for these pipe balls and he conceived the idea of jarring the sand, believing that in this way the molds could be more uniformly rammed than by any other method. His first experiment consisted of filling a flask with sand, which was jarred on a post. The results proved that his theory was correct and a number of jarring machines was built for the production of molds for pipe balls.

Subsequently he engaged in the manufacture of a pneumatic jar-ramming machine and established a plant at Pittsburgh and later moved to Sharpsburg, Pa., where larger quarters were obtained. Associated with him were his two sons, Herman C., now deceased, and Alfred, who is at present engaged in the jarring machine manufacturing business. As the plant was inadequate to meet the demands of manufacture, additional capital was obtained and the Herman Pneumatic Machine Co. was organized and a plant was built at Zelienople, Pa., in 1906. About four years ago Mr. Herman retired from business and prior to his death he served in an advisory capacity to the Herman Pneumatic Machine Co. He is survived by his widow and one son.

C. W. Leavitt & Co., Cortlandt building, New York City, have been appointed American selling agents for carbonless metals and alloys manufactured by the Iron & Steelworks Mark, Wengern-Ruhr, Germany.

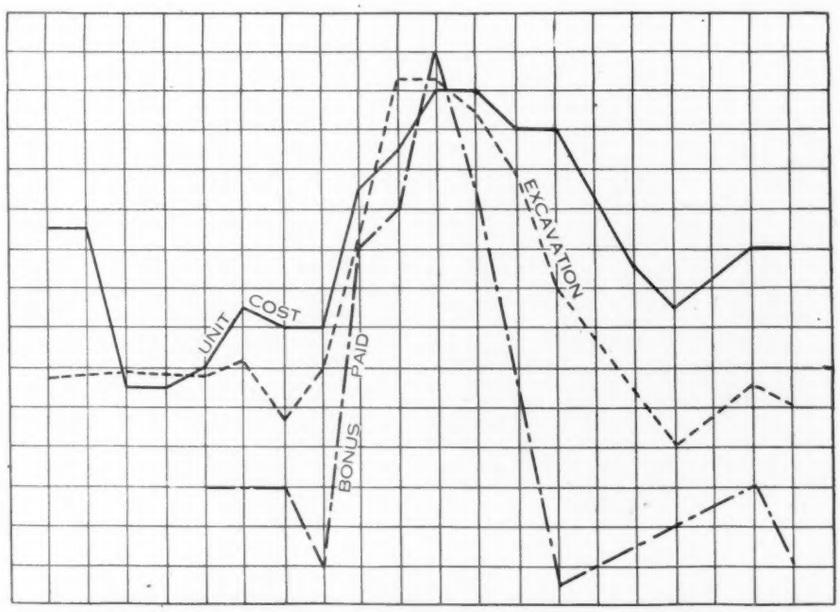
Task and Bonus Work

Manufacturers generally realize that a properly conceived and properly applied bonus system will reduce the unit cost of work. Just how much this reduction will be depends largely upon the work being done and the manner in which the bonus is applied.

The accompanying diagram shows how even such prosaic work as excavation—in midwinter—may be made to yield results in economy as well as rapidity of accomplishment. It is a record of work done by the Aberthaw Construction Co., Boston, in excavating for reinforced concrete factory buildings in New Haven, Conn., for the Acme Wire Co. and the Oven Equipment & Mfg. Co.

Work was started December 29, 1913, with frost in the ground. The building represented by the diagram is 400 x 62 feet, with basement floor about 10 feet below natural grade. As the material excavated was used in bringing up the grade of depressions about other portions of the lot, the contractors decided to use wheel scrapers. In addition to the earth excavated, quantities of good sand were taken out and placed in storage piles, to be used later in concreting. The loam and top soil were first removed by the use of plows and frost wedges.

A study of the length of haul and the number of wheel scraper loads per day showed that 120 loads—for a longer haul 110 loads—made a full day's work. The teamsters in their leisurely way and with apparent disinterest could haul at best only 120 or 130 loads. The application of the bonus



SCALE SHOWING RESULTS OF THE INTRODUCTION OF THE BONUS PLAN OF PAYMENT

to a task easily within limits of accomplishment changed the entire tone of the job from half-hearted endeavor to enthusiastic effort.

A bonus of 50 cents was given each driver who had made 120 loads or more during the day. The bonus was increased to $1 for each man who made 150 loads—a mark which several reached. It was expressly stipulated that the horses should not be mistreated in reaching bonus figures and that loads which were not full would not be credited on the tally board.

In applying the chart it will be noted that the scale of unit cost in cents per cubic yard is inverted. This was done for the purpose of making the three curves as nearly parallel as the facts would permit, and the result is a surprising uniformity in the trend of the curves, location of peaks, etc. As would naturally be expected, the unit cost was lowest when the quantity and consequently the bonus, were highest. The gain, however, from a cost of 35 cents per yard at the time the bonus was first applied to 25 cents and under for the peak of the curve, was very marked, involving as it did a saving of more than $60 a day for the excavation during the period of highest output.

The Terry Steam Turbine Co., Hartford, Conn., recently has added a large number of machine tools which will increase the capacity of the plant approximately 25 per cent. The month of May was the largest in the history of the company in the number of orders received.

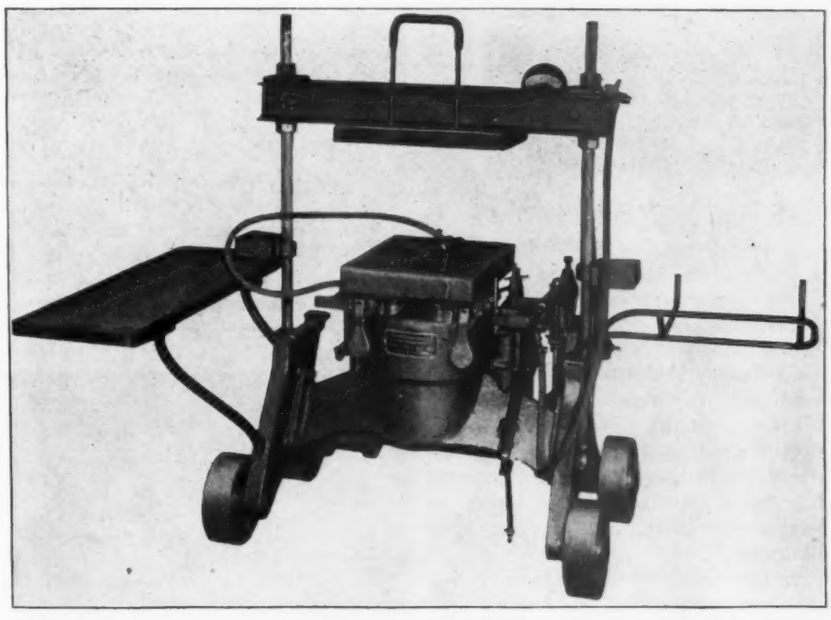
PORTABLE AIR SQUEEZER EQUIPPED WITH SAND STRADDLING LEGS

New Osborn Molding Machines

For some time the Osborn Mfg. Co., Cleveland, has been furnishing jolt ramming equipment with its power squeezers when desired. Recently a stripping plate device has been designed for the machines, so that Osborn power squeezers now may be obtained with both jolt ramming and stripping plate attachments. The characteristics of the standard air squeezer built by the Osborn Mfg. Co. are well known. The operation of the stripping plate attachment is entirely automatic under ordinary circumstances, but the device is so adjusted that it may be worked by hand without changing the adjustment of the machine. The flask lifting pins are adjustable both horizontally and vertically, and are so arranged that a large number of different sized flasks can be accommodated. Any desired depth of draw within the limit of the machine may be obtained.

When using the stripping plate attachment, the flask is placed on the machine and the mold is made in the ordinary manner; that is, the workman simply pushes down the handle of the operating valve, after which the compression is applied up to the point at which the release valve has been set. If the jolt-ramming device is used, it is operated by a separate knee valve. The stripping attachment is simple and positive in action. It is partly attached to the squeezing head and as the latter ascends to make the squeeze, the stripping mechanism is raised to its working position; after the mold has been squeezed and as the head is descending, the flask comes in contact with the stripping pin and the pattern is automatically drawn from the sand. The pattern usually is drawn at a speed equal to one-half of that at which the head is lowered. This speed, however, may be varied so that the pattern may be drawn either slowly or rapidly, according to circumstances.

The Osborn Mfg. Co. now is equipping its 8½-inch cylinder standard air squeezer with legs which are set wide apart in order to straddle a sand heap.



OSBORN AIR SQUEEZER EQUIPPED WITH JOLT RAMMING AND STRIPPING PLATE ATTACHMENT

Colors of Lenses for Protective Goggles and Masks

*By F. W. King**

It undoubtedly will prove a surprise to many manufacturers to learn that the colored glasses worn by their welders not only are unsatisfactory for the purpose intended, but in some cases are almost fatal to the eyesight of their employes. The insidious ultra violet rays, which can totally destroy animal tissue, are not being eliminated in a large percentage of the glasses in use today and in many shops,

FIG. 1—THE HELMET IN USE IN CONNECTION WITH AN ELECTRIC WELDING OPERATION IN A FOUNDRY

lenses of incorrect colors adopted 20 years ago are still in use. The writer has made investigations in more than 60 of the largest plants in the country and was surprised to find that in not a single instance was a scientific color of lens being employed, with the exception of the glasses used by the melters of Bessemer steel. Molten or incandescent steel at a temperature of more than 2,000 degrees Fahr. throws off an injurious amount of ultra violet and violet radiations and a proper color screen should be used not only to cut out these rays, but also to reduce the heat or red end of the spectrum, which, owing to their intense energy, are the chief causes of eye fatigue. Amber is an unsatisfactory color, but "Akopos" glass has been found more efficient. With the use of amber lenses a correct estimate of distance is extremely difficult to obtain and amber does not combine with the second lens placed over the first to reduce the visible spectrum, which includes the red rays, to a point that produces no eyestrain. It has been found that smoked and blue glasses commonly used are transparent to the very rays it is necessary to eliminate and their use not only is incorrect, but in some cases involves great danger. If the eye is exposed from two to three minutes to the direct rays of the arc employed in the electric welding process, which generates a temperature from 6,200 to 6,450 degrees Fahr., the eyesight will be permanently destroyed, causing total blindness.

At the present time a sheet of red glass and two sheets of blue, or one sheet each of blue, red and green are used in the shield or in a makeshift helmet. The quality of the glass also is inferior. The writer has produced a glass which in a single thickness scientifically accomplishes what is being attempted by the combination

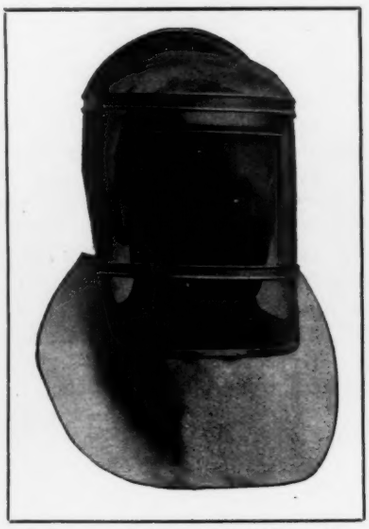


FIG. 2—HELMET DESIGNED FOR THE PROTECTION OF WELDERS

mentioned. This will be used in an aluminum helmet which protects the head and neck from the heat rays and the lens is protected by a screen of "Akopos", which may immediately be changed for a new one when it becomes pitted. The lens combination is hinged so it may be raised to allow unobstructed vision if the operator desires to walk around or pick up a tool.

It, of course, is conceded that chippers and grinders should use proper protective goggles, although if not forced to wear them, they will not do so, claiming that they have been employed as chippers for a considerable period without suffering eye accidents and consequently they presume they never will.

The operator of the oxy-acetylene welding torch, wearing smoked or blue glasses, also will claim that he has been using the same glass for years without injury to his eyes, although he does not know that this is the case. Howeyer, when he admits that they hurt his eyes, it will be too late to prevent the injury. If 2,000

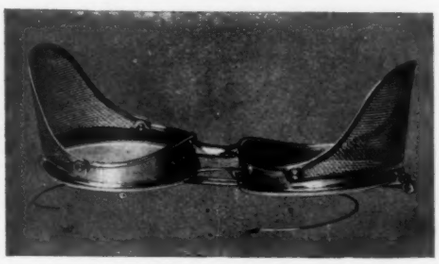


FIG. 3—THE GOGGLES WORN BY THE OPERATORS

*F. W. King Optical Co., Cleveland, O.

FIG. 1—OTIS INCLINED ELEVATOR LEADING TO CUPOLA CHARGING PLATFORM

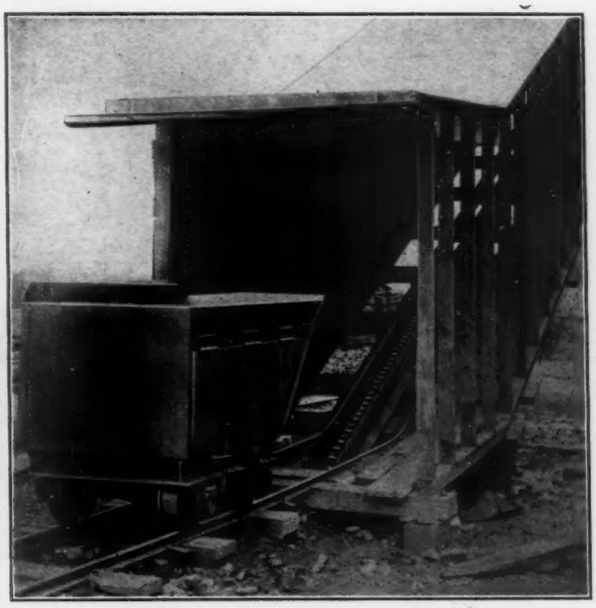


FIG. 2—ANOTHER VIEW OF ELEVATOR, SHOWING TYPE OF CHARGING CAR EMPLOYED

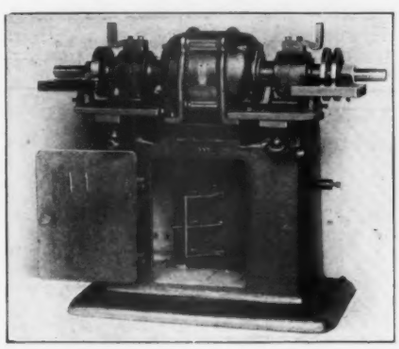
degrees Fahr. produces eye strain and 6,450 degrees Fahr. causes total blindness, what will 4,200 to 4,350 degrees Fahr. of the oxy-acetylene welder do to the eyes when the ultra violet rays are so intense? The process has not been in use sufficiently long to determine definitely what the exact results will be, but it is admitted that the colors so generally employed are not satisfactory and steps should be taken to insure the use of correct colored lenses.

With the exception of glasses worn for electric arc welding, proper glasses will enable the wearer to walk about with unobstructed vision and no form of bifocals, with dark glass above and light below, is necessary. Smoked lenses are so transparent to the ultra violet rays that they afford practically no protection and, in addition, many of them are of the curved or coquille shape. Some of these lenses are simply pressed out and polished and are not made from optical glass. Therefore, if broken, there is great danger from splinters of glass entering the eyes, as the splinters will fly off from the inside of the lens. All of these lenses have a more or less concave focus, making the eye artificially hypernetropic, with consequent eye strain. One pair obtained by the writer from a large plant measured —.50 combined with —.50 cylinder with an odd axis when they were supposed to be plano.

The E. J. Woodison Co., Detroit, manufacturer of foundry supplies and equipment, has established a Buffalo office at 378 Ellicott Square building, in charge of Pierce G. Smith.

Ball-Bearing Grinding Machine

A new motor-driven, dry grinding machine recently has been placed on the market by the Ransom Mfg. Co., Oshkosh, Wis. It is designed for either belt or motor drive, with wheels 16 inches in diameter or larger. The machine shown in the accompanying illustration is suitable for operating two 24 x 4-inch abrasive wheels. The motor



BALL-BEARING GRINDING MACHINE

is securely bolted to the main frame of the machine. The rotor spindle is 2 inches in diameter at the wheel fit and 2 5-8 inches in diameter between the bearings. The shaft is supported on either side of the motor by ball bearings of the double rim, self-aligning type. The ball races fit into 5 1-5-inch housings, which are held securely in the frame. It is claimed that after one of these machines had been operated on heavy foundry grinding for five months there was no appreciable wear on the ball bearings.

The Titanium Alloy Mfg. Co., Niagara Falls, N. Y., announces that it has organized a bronze department for the manufacture of titanium-bronze specialties under its various patents. W. M. Corse, formerly works manager of the Lumen Bearing Co., Buffalo, and lately general manager of the Empire Smelting Co., Depew, N. Y., will be associated with the company as manager of this department.

Inclined Elevator to Charging Platform

Although used extensively for many years by large mercantile houses and railway terminals to transport freight from one level to another, the initial application of the inclined elevator to service in manufacturing plants is comparatively recent. It is interesting to note that one of the first plants to be equipped with this apparatus is a foundry, that of the Fox Furnace Co., Elyria, O. This company, until recently, handled its cupola charging materials in the regular manner, loading them onto wheelbarrows in the storage yard and carrying them up to the charging platform by means of an elevator. Recently the company equipped its storage yard with industrial cars operating on narrow-gage tracks, and for elevating these to the charging floor, decided to do away with the old elevator, replacing it with one of the new inclined type developed by the Otis Elevator Co., New York City, for industrial purposes.

This elevator, as shown in the accompanying illustrations, consists of a single, endless chain, which moves in a steel channel grove and passes

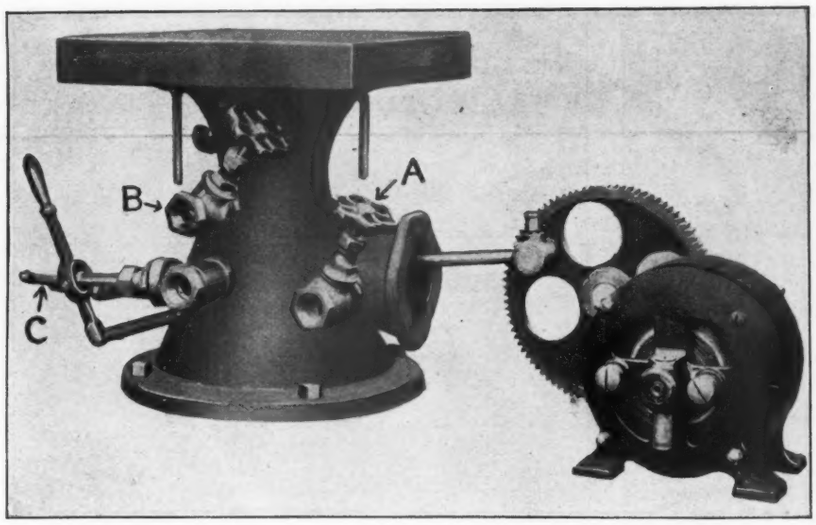


FIG. 1—SELF-CONTAINED PNEUMATIC JAR-RAMMING MACHINE

over sprocket wheels at the top and bottom of the incline. The chain is provided with projecting teeth and is operated by means of spur gear and silent chain drive, by a nine-horse-power motor, which is reversible, thus permitting the movement of trucks both up and down the incline. The trucks, after having been loaded with the charging materials, are pushed along the narrow-gage track to the foot of the incline, where the teeth of the chain engage a flange at the bottom of each truck, thus pulling it up to the charging floor. Here, by means of hopper doors, the contents of the trucks are dumped and the latter again are returned to the incline to be lowered to the yard level. The chain moves at a speed of 70 feet per minute and under existing operating conditions carries about 4,000 pounds at each load. The cost of handling the charging materials in this manner is equal to about half the cost by the power method.

The length of the incline is 47½ feet and the vertical rise is 20 feet. As is shown in the illustrations, the cars run up the incline on narrow-gage tracks. The incline also is provided with a foot-way.

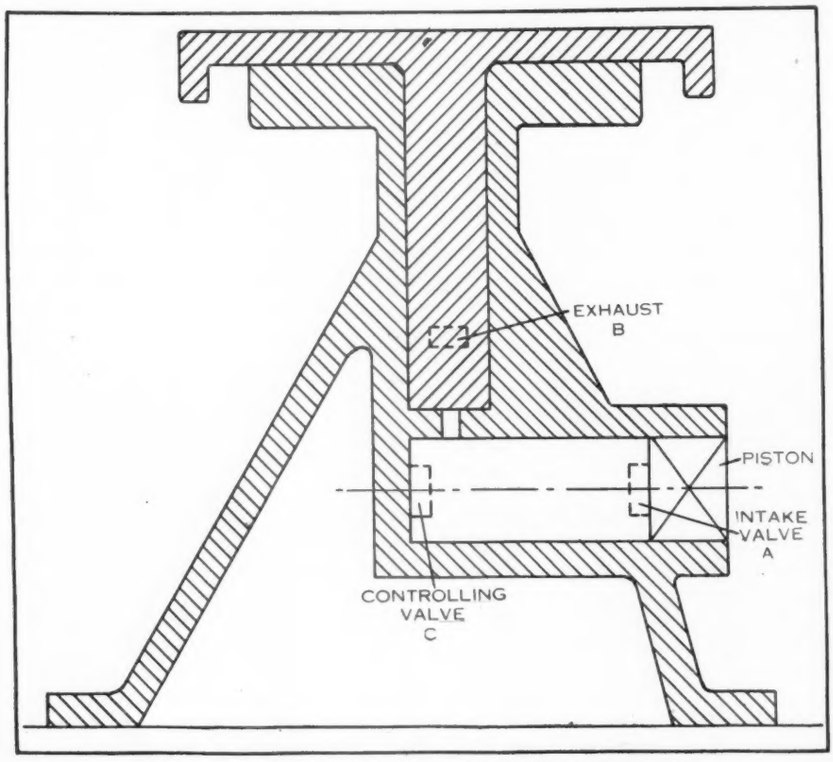
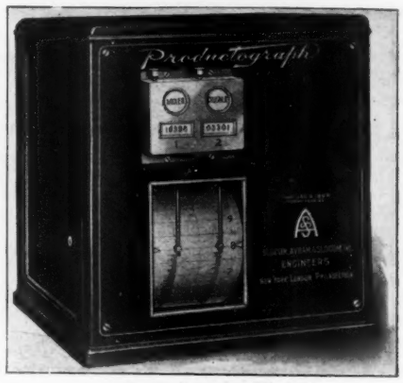


FIG. 2—SECTIONAL VIEW OF JAR-RAMMING MACHINE

Pneumatic Jar-Ramming Machine

An exceedingly interesting pneumatic jar-ramming machine has been designed by William T. Krause, 3,623 North Ashland avenue, Chicago, in which the air is compressed directly by an electric motor attached to the machine. As shown in Figs. 1 and 2, air at atmospheric pressure is admitted to the horizontal cylinder through the intake valve *A*, and is compressed sufficiently to raise the plunger and table in the vertical cylinder until the plunger uncovers the exhaust port *B*, when the compressed air exhausts and drops the table and plunger. The horizontal and vertical cylinders are connected by a small air port. The motor will be operated constantly, and the operation of the machine will be controlled by opening and closing the gate valve *C*, and in this manner the use of a clutch will be obviated.

In Fig. 1, valve *C* is shown open. By substituting a three-way valve for valve *C*, sufficient air can be compressed while the machine is not jolting to operate the vibrator, blow gun and to store air in a tank to raise the plunger and table for pattern drawing. In Fig. 1 the gear case with which the machine is equipped has been removed. The exhaust will be connected to the gear case, thereby using the exhaust air, containing a certain amount of oil, to lubricate the moving parts and at the same time to create a very low air pressure in the gear case, which will leak out through the joints of the case and blow away sand that may tend to work its way into the gear case.



PRODUCTOGRAPH USED FOR RECORDING THE OPERATIONS OF MACHINES

The Productograph

In carrying on its work, the engineering firm of Slocum, Avram & Slocum, Inc., 30 Church street, New York City, found it impossible to obtain an absolutely correct record of machinery operations in plants for which its services as production engineer were engaged. Reports of ope-

rations were more or less unreliable and, therefore, it was decided to devise an instrument for its own use, which, when attached to machinery will record permanently and accurately just what the machines are doing, periods of their activity and idleness, their average, as well as maximum capacity, and which will finally count the production in whatever units this may be desired. This device attracted the attention of many manufacturers and the productograph now is being built for the trade.

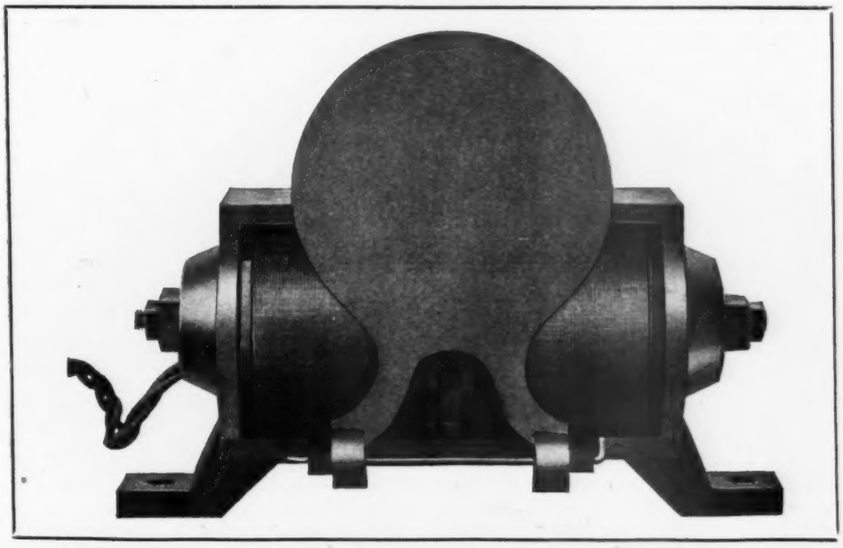
It is claimed that the major portion of lost efficiency in a plant is due to lost time on machinery operations, and as machinery is the primary investment in every works, it should be made to produce its maximum under ideal conditions.

The productograph can be placed in the private office of the owner or manager of the plant and then is wired to the machinery in the shop. It will record in a permanent way the exact starting and stopping time, the number of stoppages during the day and their duration, the rate of speed and of production with variations, and finally it will count the output according to requirements. It is claimed that the machine is particularly adapted to punching presses and molding machines. However, it can be applied in any plant where machinery is used. The accompanying illustration shows a machine of the two-needle size, which can be connected to two machines of like or different kind. The instrument, however, also is made in larger sizes, being equipped with 5, 10 and 20 needles. The chart is renewed every day and is divided by vertical lines into spaces for each machine. When a machine commences work, the pin makes a mark across the chart in a space corresponding to the machine. This marking is arranged so that the rate of working can be seen at a glance, each 100th mark, or multiple thereof, being extended, as shown in the illustration.

Electric Vibrator

An electric vibrator for rapping patterns mounted on molding machines, for attachment to brass molders, tubs, sand shakers, etc., is now offered to the foundry trade by the International Electric Tool Co., Milwaukee. The vibrator is attached underneath the table of the machine and a knee pad is provided by which the current is cut on and off without the operator taking his hands from his work. It is claimed that the power consumption is very small. The vibrator is simple of construction, consisting of a solenoid surrounded by an iron frame and a steel plunger. There are no moving electric contacts or connections except the starting switch. The plunger is smaller in diameter than the cylinder in which it moves and is held in the center of the cylinder by the magnetic force of the solenoid which prevents friction between the plunger and cylinder and avoids the necessity of lubrication.

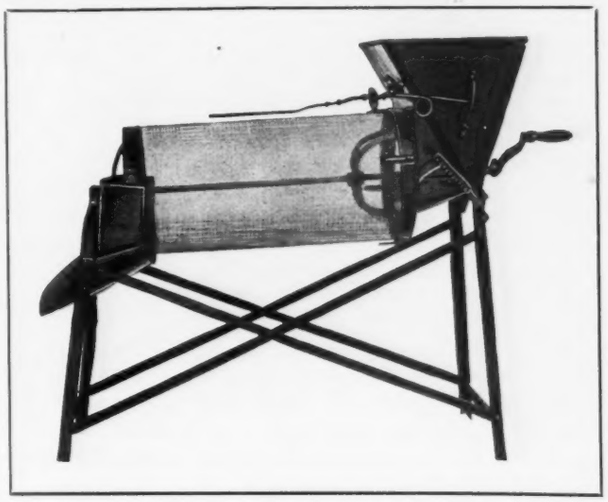
The vibrator is furnished in various sizes for molding machines or bench work or may be attached directly to the pattern. It is operated on direct current, but on alternating current, a three-wire generator is used, which can be driven by the line shaft or direct connected.



ELECTRIC VIBRATOR MANUFACTURED BY THE INTERNATIONAL ELECTRIC TOOL CO.

A New Sand-Sifting Machine

A portable sand-sifting machine, particularly adapted for foundry use, built by the Hall-Holmes Mfg. Co., Jackson, Mich., is shown in the accompanying illustration. The cylinder and sand hopper are mounted on four well-braced legs, the revolving cylinder being 14 inches in diameter and 30 inches long. The top of the hopper is about 4 feet from the ground and the crank-shaft is about 3 feet from the floor level. While the crank is attached to the machine in the accompanying illustration, a pulley may be used for operating the sifter if desired. A feature of this machine is a tapping device which can be regulated easily by the operator to strike light or heavy blows, or its use can be eliminated entirely. Either wet or dry sand can be screened. The entire machine is of metal construction, the hopper and gravel chute being made of heavy galvanized iron and the legs are steel angles.



PORTABLE SAND SIFTING MACHINE

The cylinder is supported by a ¾-inch steel shaft and the wheels in the cylinder have been specially constructed with a view of permitting the passage of coarse material. The screen, which is No. 4 mesh, is clamped in position by two spring steel bands and can be easily removed when a coarser or finer mesh screen is desired. A cut-off in the bottom of the hopper regulates the amount of sand fed into the screen and this device can readily be controlled by the operator.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Jackson Metal Products Co., Jackson, Mich., has acquired the plant formerly occupied by the State Foundry Co.

The Pittsburgh Conveying Machine Co. has purchased the plant of the East Liverpool Foundry & Machine Co., East Liverpool, O., where it will establish its plant.

John D. Miller, Charlestown, W. Va., is negotiating with the Commercial Club of Lancaster, O., for a site on which to erect a foundry for the manufacture of car wheels and railroad equipment.

The Beloit Nickel Plating & Mfg. Co., Beloit, Wis., has purchased the plant of the Beloit Creamery Co. and is installing general machine shop and plating equipment in addition to a complete installation of welding and cutting apparatus.

The United States Malleable Iron Co., Toledo, is rebuilding its core room and a portion of its foundry department, which were damaged by fire May 15 to the extent of approximately $35,000. Only slight damage was done to the melting furnaces and temporary quarters for the departments affected have been established.

The plant of the Emerson-Brantingham Co., Waynesboro, Pa., has been leased for a term of years by the Waynesteel Corporation and will be operated as a steel foundry. The company has been capitalized at $250,000 and the officers have been elected as follows: Henry D. Reynolds, president and chairman of the board of directors and E. Cooper Wills, vice president and general manager.

New Construction

The Arneson Foundry Co., Kenosha, Wis., is building an addition to its plant which will be operated as a steel foundry. A converter is being installed.

The Simmons Mfg. Co., Kenosha, Wis., is extending its plant by the erection of two large buildings, of brick and steel construction. One building, 60 x 200 feet, will contain the gray iron foundry, brass foundry and blacksmith shop, and the other building, 60 x 260 feet, will contain the machine shop, pattern shop and drafting room.

The Erie Foundry Co., Rochester, N. Y., has purchased the casting shop of the American Laundry Machinery Co. on Dewey avenue of that city and is refitting it to be used as a jobbing gray iron foundry devoted especially to the production of machinery castings. An addition to this plant, 30 x 145 is being erected, which will greatly increase the molding floor area, and a new cleaning shop 40 x 100 also is being built. The melting equipment will be greatly increased by the installation of a 72-inch cupola. The capacity of this plant, when extensions are completed, will be practically double that of the present shop of the Erie Foundry Co. on Lyell avenue

Among the Brass Founders

The Enterprise Smelting & Refining Co. has been incorporated in New York City with a capital of $5,000. The address of the new concern is 1461 Forty-first street, Brooklyn.

The National Bronze Foundry Co., Buffalo, has moved into the plant formerly occupied by the American Bronze Co., at 1413 Niagara street. This shop has considerable more capacity than the one formerly occupied by the National Bronze Foundry Co.

The Swan Carburetor Co., San Francisco, has been incorporated with a capital of $20,000 by H. S. Hutchins, E. M. Boynton and B. W. Boynton, of San Francisco.

The Perkins Valve Co., Elkhart, Ind., has been incorporated with a capital of $5,000 to manufacture plumbing supplies. The incorporators include Joseph G. Perkins, Frank E. Bortel, of South Bend, and Richard Turnock, of Elkhart, Ind.

The Summer street foundry of the Wells Chemical & Bronze Works, Worcester, Mass., is to be razed in order to make room for a new building to be erected by Armour & Co., of Chicago. The Wells company has purchased property at Harding and Temple streets, Worcester, and will erect a new foundry 40 x 60 feet, a contract for which has been let to Edward D. Ward, a Worcester building contractor. The new foundry will be of brick construction and will include one-story and a basement.

Owing to the demand for its Hydraulic valves and fittings, the Hydraulic Press Manufacturing Co., Mount Gilead, O., recently extended its brass foundry and this department now occupies the entire building, 90 feet long and 30 feet wide. It is equipped with three furnaces which melt the metal for all of the company's valves and fittings and a considerable amount of contract brass casting work also is done.

NEW TRADE PUBLICATIONS

ELECTRIC DRILLS.—A four-page folder, issued by the Independent Pneumatic Tool Co., Chicago, is devoted to its extensive line of electric drills adapted for foundry and machine shop service.

SAND DRYERS.—The Indiana Foundry Co., Indiana, Pa., in an eight-page circular illustrates and describes its line of sand dryers which are adapted for drying sand in foundries and for other industrial purposes. These dryers are made in three sizes in capacities from three to 10 tons daily.

AIR HOISTS.—A 20-page catalog recently issued by the Whiting Foundry Equipment Co., Harvey, Ill., is devoted to its line of air hoists adapted for use in foundries for rolling over and closing molds and for other miscellaneous work for which a hoist of this kind is adapted. In addition to vertical, horizontal hoists also are illustrated and described and numerous views are included, showing the method of handling air hoists in foundries and other industrial establishments.

BUBBLING FOUNTAINS.—A handsomely illustrated 70-page catalog issued by the Rundle-Spence Mfg. Co., Milwaukee, illustrates and describes various types of sanitary drinking fountains for installation in industrial plants, public buildings, offices, parks, etc. With the advent of the summer months the installation of these fountains in industrial plants usually is given more careful consideration than at any other time of the year and the various types shown meet every requirement of manufacturing establishments, as well as the specifications of various boards of health.

ELECTRIC HOISTS.—The Sprague Electric Works of the General Electric Co., 527 West Thirty-fourth street, New York City, has issued a 32-page booklet devoted to electric hoists, adapted to a variety of handling operations in industrial plants. Numerous views of the application of these hoists are included and various types of this device are shown. A number of other booklets also have been issued by the Sprague Electric Works, which are devoted to electric fans, plug connectors, water-tight floor boxes, etc.

WOODWORKING MACHINES.—The Crescent Machine Co., Leetonia, O., illustrates and describes its extensive line of woodworking machinery in a 144-page catalog recently issued. A tool built by this company and described at length in this catalog is a universal woodworker, which consists of a band saw, jointer, saw table, borer and shaper. The machine may be purchased without band saw and shaper and other attachments may be added, adapting the machine for mortising, making mouldings, grinding tools, sanding, etc. This machine is intended particularly for users of woodworking machines who feel that they cannot afford a complete outfit of individual machines for the various operations performed by the universal tool. A varied line of pattern shop machinery is shown and the catalog in every respect is unusually complete.

FRENCH MOLDING MACHINES. — Ph. Bonvillain & E. Ronceray, Paris, France, manufacturers of molding machines and labor-saving foundry equipment, have issued an exceedingly interesting and comprehensive 104-page catalog, which clearly illustrates and describes the various types of molding devices built by this company. The practice abroad has reached its highest development in the use of hydraulic power for operating mold-making devices, although many simple machines, not power operated, also are shown, Stripping plates, match plates, etc., likewise have reached a high state of development in France, largely through the efforts of this company, and the methods of their production are clearly shown and described. Large power-operated machines also are illustrated, which are adapted for almost every conceivable use. The catalog is exceedingly interesting, particularly as it reflects the rapid growth in power-operated labor-saving foundry equipment abroad.